Instruction Manual
Doc Number CI-ControlWave Micro
Part Number D301392X012
June 2013

ControlWave® Micro
Process Automation Controller

Remote Automation Solutions
www.EmersonProcess.com/Remote

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Process Management

IMPORTANT! READ INSTRUCTIONS BEFORE STARTING!

Be sure that these instructions are carefully read and understood before any operation is attempted. Improper use of this device in some applications may result in damage or injury. The user is urged to keep this book filed in a convenient location for future reference.

These instructions may not cover all details or variations in equipment or cover every possible situation to be met in connection with installation, operation or maintenance. Should problems arise that are not covered sufficiently in the text, the purchaser is advised to contact Emerson Process Management, Remote Automation Solutions for further information.

EQUIPMENT APPLICATION WARNING

The customer should note that a failure of this instrument or system, for whatever reason, may leave an operating process without protection. Depending upon the application, this could result in possible damage to property or injury to persons. It is suggested that the purchaser review the need for additional backup equipment or provide alternate means of protection such as alarm devices, output limiting, fail-safe valves, relief valves, emergency shutoffs, emergency switches, etc. If additional information is required, the purchaser is advised to contact Remote Automation Solutions.

RETURNED EQUIPMENT WARNING

When returning any equipment to Remote Automation Solutions for repairs or evaluation, please note the following: The party sending such materials is responsible to ensure that the materials returned to Remote Automation Solutions are clean to safe levels, as such levels are defined and/or determined by applicable federal, state and/or local law regulations or codes. Such party agrees to indemnify Remote Automation Solutions and save Remote Automation Solutions harmless from any liability or damage which Remote Automation Solutions may incur or suffer due to such party's failure to so act.

ELECTRICAL GROUNDING

Metal enclosures and exposed metal parts of electrical instruments must be grounded in accordance with OSHA rules and regulations pertaining to "Design Safety Standards for Electrical Systems," 29 CFR, Part 1910, Subpart S, dated: April 16, 1981 (OSHA rulings are in agreement with the National Electrical Code).

The grounding requirement is also applicable to mechanical or pneumatic instruments that include electrically operated devices such as lights, switches, relays, alarms, or chart drives.

EQUIPMENT DAMAGE FROM ELECTROSTATIC DISCHARGE VOLTAGE

This product contains sensitive electronic components that can be damaged by exposure to an electrostatic discharge (ESD) voltage. Depending on the magnitude and duration of the ESD, this can result in erratic operation or complete failure of the equipment. Read supplemental document S14006 for proper care and handling of ESD-sensitive components.

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Chapter 1 – Introduction

This manual focuses on the hardware aspects of the ControlWave® Micro hybrid controller (called the "ControlWave Micro" or "Micro" throughout the rest of this manual). For information about the software used with the Micro, refer to the *ControlWave Micro Quick Setup Guide* (D5124), the *ControlWave Designer Programmer's Handbook* (D5125), and the online help in ControlWave Designer.

This chapter details the structure of this manual and provides an overview of the ControlWave Micro and its components.

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ControlWave products have been designed and integrated as a highly adaptable, high performance distributed open controller family with exceptional networking capability that provides a complete process automation management solution for the natural gas, water, and wastewater industries. The ControlWave Micro was designed with an emphasis on providing high performance with low power consumption, scalability, and modularity.

Base housings are available with backplanes that support one, two or six I/O modules. Optional expansion housings attach to either the 4- or 8-slot base housing and support two, four, or eight I/O modules.

Note: The 3-slot base housing does not include a plug-in connection to any expansion housings.

Features

ControlWave Micros have the following key features:

- Exceptional performance and low power consumption through use of the ARM microprocessor
- Small size (enabling panel- or wall-mount installations)
- One or two RS-232 and one RS-485 asynchronous serial communication ports
- One or two optional 10/100 MB Ethernet ports
- Optional Expansion Communication modules (ECOMs) with optional built-in modem and/or radio

- 3-, 4- and 8-slot base housings with 2-, 4-, or 8-slot I/O expansion housings
- Wide operating temperature range: (–40 to +70°C) (–40 to 158°F)
- Variety of I/O modules (including mixed I/O) for cost-effective small RTU applications
- LED status indicators on the CPU, PSSM, and I/O modules
- Lithium coin cell battery (located on the CPU module) provides battery backup for the real-time clock and the system's static RAM (SRAM)
- CE and Class I, Division 2 Hazardous Location approvals

1.1 Scope of the Manual

This manual contains the following chapters:

Chapter 1 Introduction	Provides an overview of the hardware and general specifications for the ControlWave Micro.
Chapter 2 Installation	Provides information on the base and expansion housings, the Power Supply/Sequencer module (PSSM), the CPU module, the Expanded Communications module (ECOM), and related peripherals such as the optional keypad.
Chapter 3 I/O Modules	Provides general information and wiring diagrams for the I/O modules.
Chapter 4 Operation	Provides information on day-to-day operation of the ControlWave Micro.
Chapter 5 Service and Troubleshooting	Provides information on service and troubleshooting procedures.

1.2 Physical Description

Each ControlWave Micro has a printed circuit board (PCB) backplane mounted in an aluminum housing, a Power Supply/Sequencer Module (PSSM), a CPU module, and—depending on the backplane and housing size—from zero to six I/O modules. See *Figure 1-1* Expansion housings (in 2-, 4-, or 8-slot configurations) attach to the base housing and enable you to add up to eight more I/O modules.

You can insert optional expansion communication modules (ECOMs) in slots #3 and #4 of the base housing in place of I/O modules.

Refer to the following sections in this chapter or to other chapters in this manual for further information:

- Base and expansion housings (chassis) with backplanes (see *Section 1.3* and *Chapter 2)*

- Power Supply/Sequencer module (PSSM) (see *Section 1.5* and *Chapter 2)*
- CPU module (see *Section 1.4* and *Chapter 2*)
- One or more I/O modules (see *Section 1.7* and *Chapter 3*)
- Optional Expansion Communication modules (ECOMs) (see *Section 1.6* and *Chapter 2*)
- Peripheral components (such as keypad) (see *Chapter 2*)

Figure 1-1 shows an 8-slot base housing with PSSM and CPU modules installed.

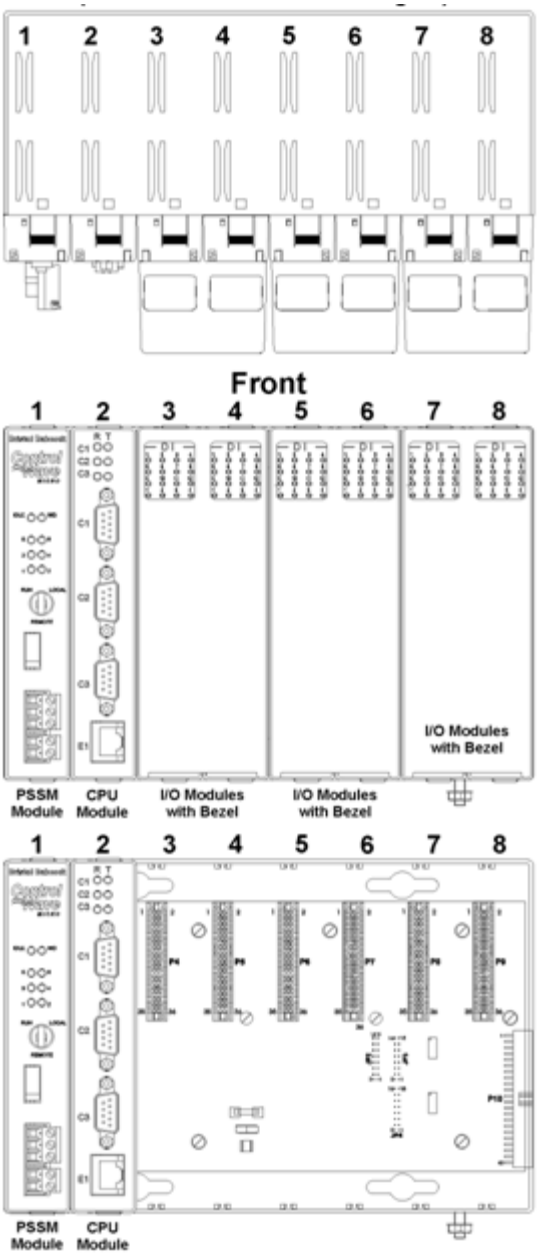
1 2 3 4 5 6 7 8
Front
1 2 3 4 5 6 7 8
I/O Modules with Bezel
PSSM Module
CPU Module
I/O Modules with Bezel
I/O Modules with Bezel
1 2 3 4 5 6 7 8
PSSM Module
CPU Module

Figure 1-1. 8-slot Base Housing (without 6 I/O Modules

1.3 Housings

ControlWave housings (whether base or expansion) are gold irridite-plated aluminum designed either for wall, DIN rail, or panel-mounting. They contain the printed circuit board (PCB) backplane that provides connections for the PSSM, the CPU module, any ECOMs, and any I/O modules.

Base Three base housings are available:

- 3-slot base backplane supports one PSSM, one CPU, and one I/O module.
- 4-slot base backplane supports one PSSM, one CPU, and two I/O modules.
- 8-slot base housing supports one PSSM, one CPU, and up to six I/O modules.

You can substitute one or two ECOMs for I/O modules in slots 3 and 4 (if present) of the base housing.

Expansion Three optional expansion housings enable you to add two, four, or eight I/O modules. However, you **cannot** install ECOMs in an expansion housing.

Note: For complete technical details on housings, refer to the ControlWave Micro technical specification (*CWM*).

1.4 CPU Module

The CPU (central processing unit) module houses the multi-layer PCB, which contains the ControlWave Micro CPU, I/O monitor/control, memory, and communication functions.

The CPU module includes:

- Sharp LH7A400 System-on-Chip ARM microprocessor with 32-bit ARM9TDMI Reduced Instruction Set Computer (RISC) core, operating at 1.8V with a system clock speed of 33 MHz and 150 MHz.
- one or two RS-232 communication ports,
- one RS-485 communication port
- zero, one, or two 10/100baseT Ethernet ports
- 2 MB of battery backed Static RAM (SRAM),
- 64MB of Synchronous Dynamic RAM (SDRAM),
- 512KB boot/downloader Flash,
- 16MB simultaneous read/write Flash memory
- transmit (TX) and receive (RX) LEDs for each communication port
- configuration DIP switches (described in *Chapter 2.*)

CPU Module Configurations

The CPU module has several basic configurations, all of which have an on-board backup battery and different combinations of communications ports:

Table 1-1. CPU Module Configurations

Number of RS-232 Ports	Number of RS-485 Ports	Number of Ethernet Ports	See Figure
2	1	0	left side of *Figure 1-2*
2	1	1	right side of *Figure 1-2*
1	1	2	*Figure 1-3*

Note: Do not confuse the CPU module (which has communication components) with the Expansion Communication module (ECOM), which **does not** have a CPU component or a battery backup but **does** have additional communication components.

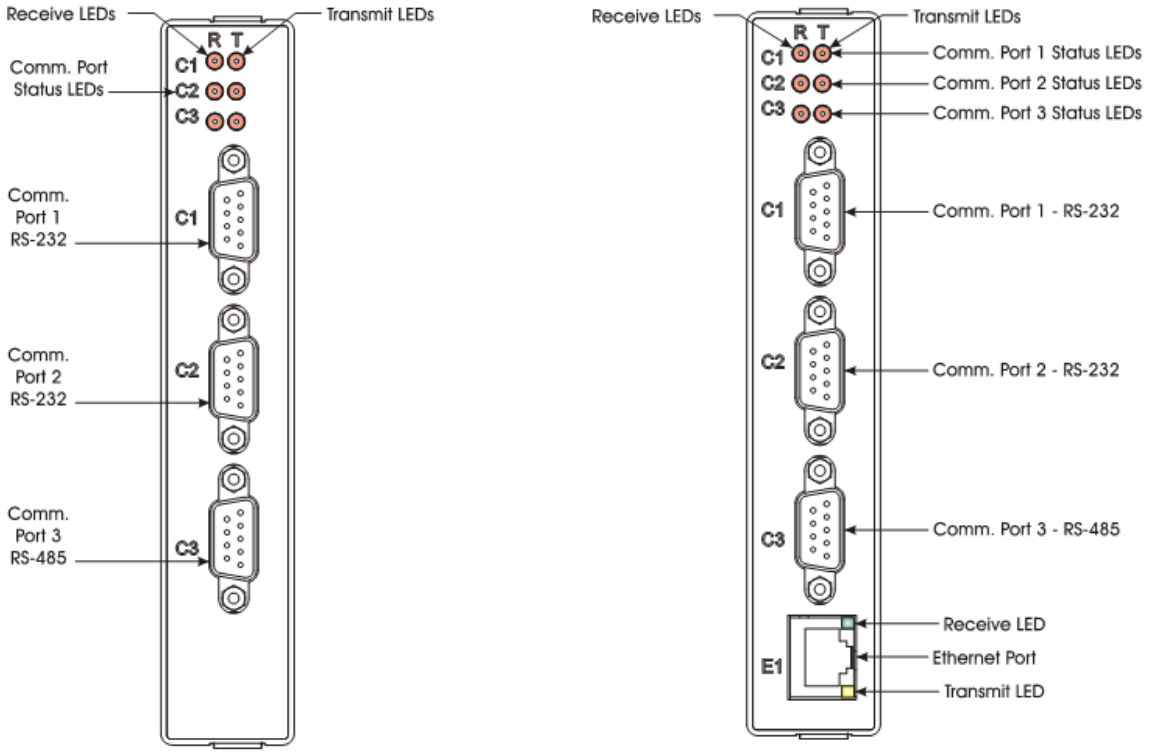

Figure 1-2. CPU Module with Three Serial Ports (left) and One Ethernet Port (right)

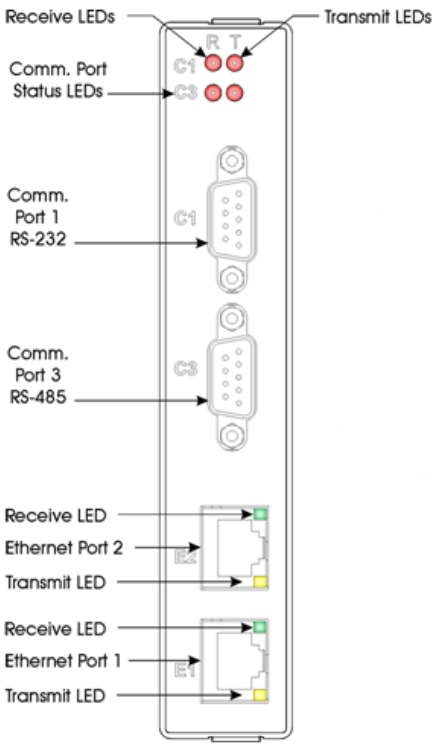

Figure 1-3. CPU Module with Two Serial and Two Ethernet Ports

CPU Backup Battery CPU modules have a coin cell socket that accepts a 3.0V, 220 mA-hr lithium battery. This battery provides backup power for the real-time clock and the system's Static RAM (SRAM).

CPU Memory There are several different types of memory used on the CPU module:

Boot/Downloader FLASH

Boot/download code is contained in a single 512 Kbyte FLASH chip. Boot FLASH also holds the value of soft switches, audit/archive file configurations, and user account and port information.

FLASH Memory

The CPU module contains 16 MB of FLASH memory. The FLASH memory holds the system firmware and the boot project. Optionally FLASH memory also stores the zipped ControlWave project (*.zwt), user files, and historical data (audit/archive files).The FLASH does not support hardware write protection.

System Memory (SRAM)

The CPU module has 2 MB of static random access memory (SRAM). During power loss periods, SRAM enters data retention mode (powered by a lithium backup battery). Critical system information that must be retained during power outages or when the system has been disabled for

maintenance is stored here. This includes the last states of all I/O points, audit/archive historical data (if not stored in FLASH), the values of any variables marked RETAIN, the values of any variables assigned to the static memory area, and any pending alarm messages not yet reported.

SDRAM

The CPU module contains 64MB of synchronous dynamic random access memory (SDRAM). SDRAM holds the running application (ControlWave project) as well as a copy of system firmware and the current values of any variables not marked RETAIN or stored in the static memory area. This allows the system to run faster than it will from the SRAM memory. SDRAM is not battery-backed.

1.5 Power Supply/ Sequencer Module (PSSM)

The Power Supply/Sequencer module (PSSM) takes power from an external bulk DC power supply and then provides power through the ControlWave Micro housing/backplane to all installed modules.

The PSSM operates from +10.7 to +30 Vdc or from +21.7 to +30 Vdc. You configure the nominal input supply configuration (12V or 24V) using configuration jumper switches on the PSSM.

The PSSM includes:

- a wide input range Vin to 3.3V DC to DC Converter
- 1200 msec good power detection circuitry
- Vin out-of-specifications detection circuitry
- Watchdog output connector
- Status LEDs
- Vin 12-bit serial analog to digital converter

There are two versions of the PSSM currently available for the ControlWave Micro. One version includes a keyed run/remote/local switch (see *Figure 1-4*); the other version includes a mode switch (see *Figure 1-5*). *Chapter 2* includes instructions for setting these switches and configuring the PSSM.

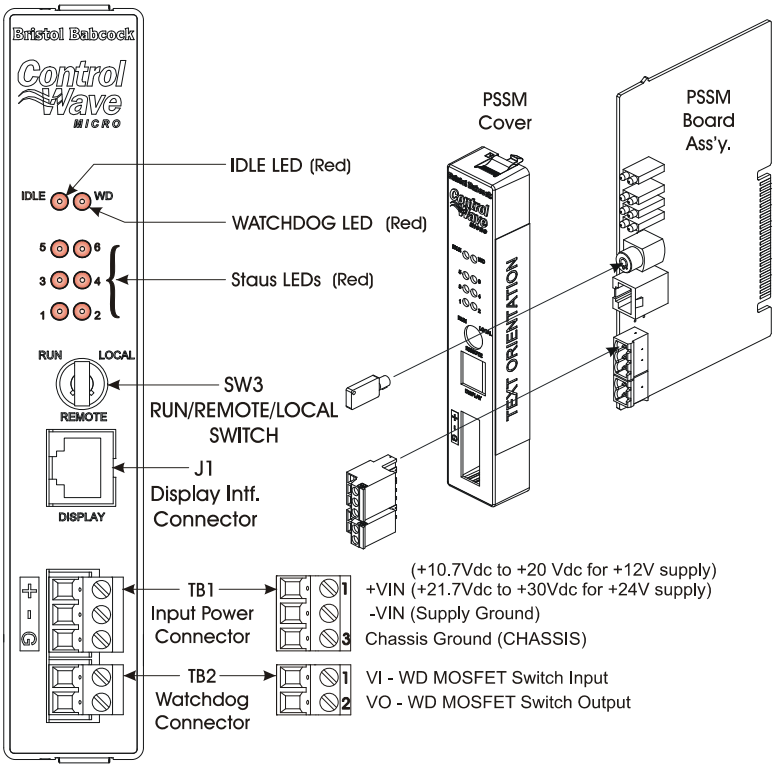

Figure 1-4. PSSM (with Run/Local/Remote Switch)

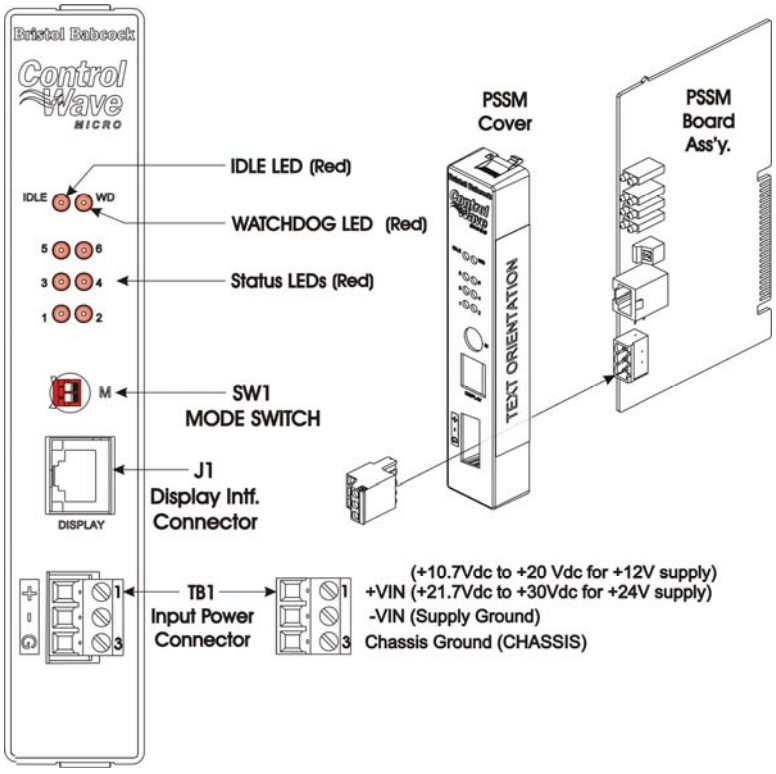

Figure 1-5. PSSM (with Mode Switch)

Board Fuse The PSSM is fused to protect the entire system using a 5x20mm slow blow fuse F1 rated at 3 Amps.

1.6 Expansion Communications Modules

An optional Expansion Communications module (see *Figure 1-6*) provides two additional serial communications ports and optionally a piggy-backed dial-up modem. Two basic versions of the module are available. Both serial communication ports support speeds of up to 115.2 KB. The top communication port (labeled C1) supports RS-232 operation while the second port (labeled C2) supports RS-485 operation. Additionally, you can order the RS-485 port with isolation to 500 Vdc.

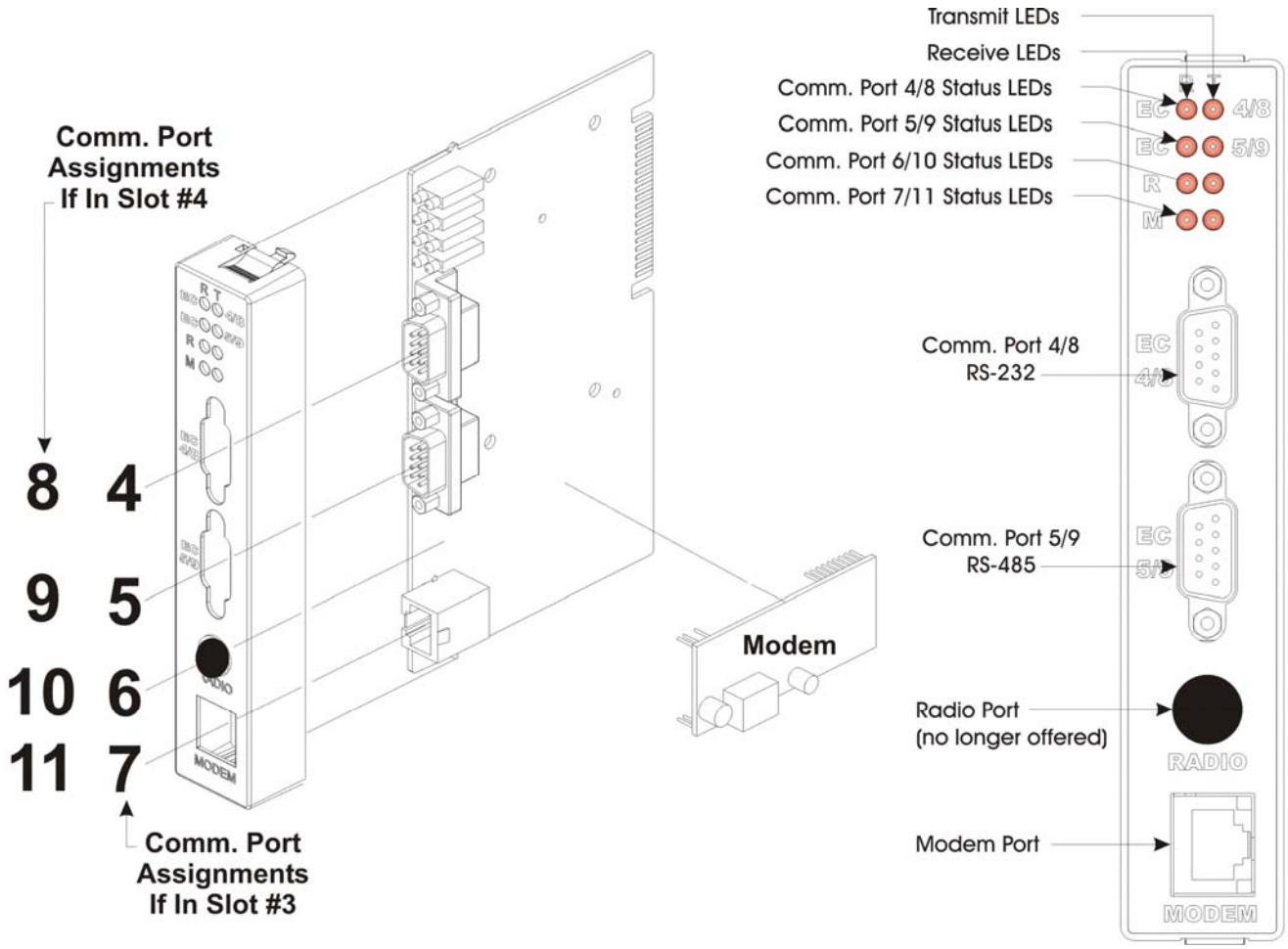

Figure 1-6. Expansion Communications (ECOM) Module

1.7 I/O Modules

The ControlWave Micro supports a wide array of factory-configured I/O modules including analog I/O, digital I/O, high speed counter, and several others for either local or remote field device wiring termination.

Refer to *Chapter 3* for information on specific I/O modules. *Figure 1-7* shows a typical I/O module housing.

Configuration jumpers on I/O modules accommodate individual field I/O user configuration. Terminations are pluggable and accept a

maximum wire size of #14 AWG. All I/O modules have surge protection that meets C37.90-1978 and IEC 801-5 specifications. Each I/O module connects to the backplane using a 36-pin male card-edge connector. All I/O modules are provided with two 10-point terminal block assemblies (for local termination) or two 14-pin mass Termination headers (for remote termination).

All digital (or discrete) I/O modules have individual point LED status indicators that you can enable either with a jumper on the module or through a software setting.

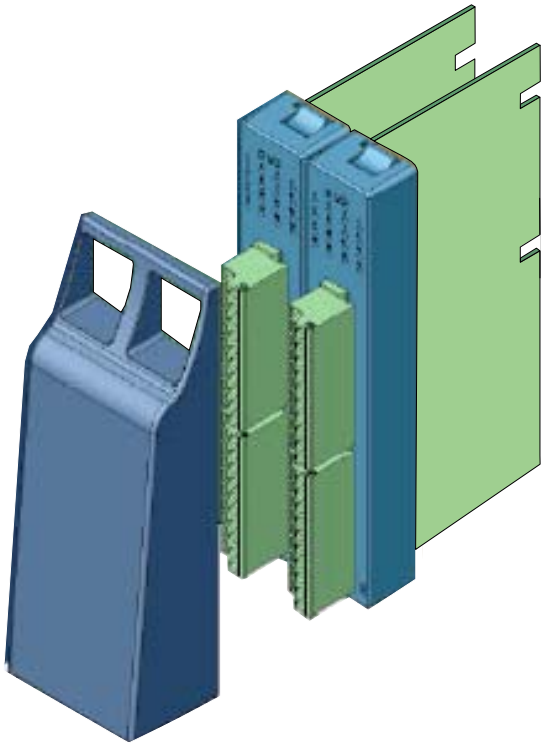

Figure 1-7. Two ControlWave Micro I/O Modules (with Bezel)

1.8 Software Tools

The ControlWave programming environment consists of a set of integrated software tools which allow you to create, test, implement, and download complex control strategies for use with the ControlWave Micro. *Figure 1-8* graphically presents the programming environment.

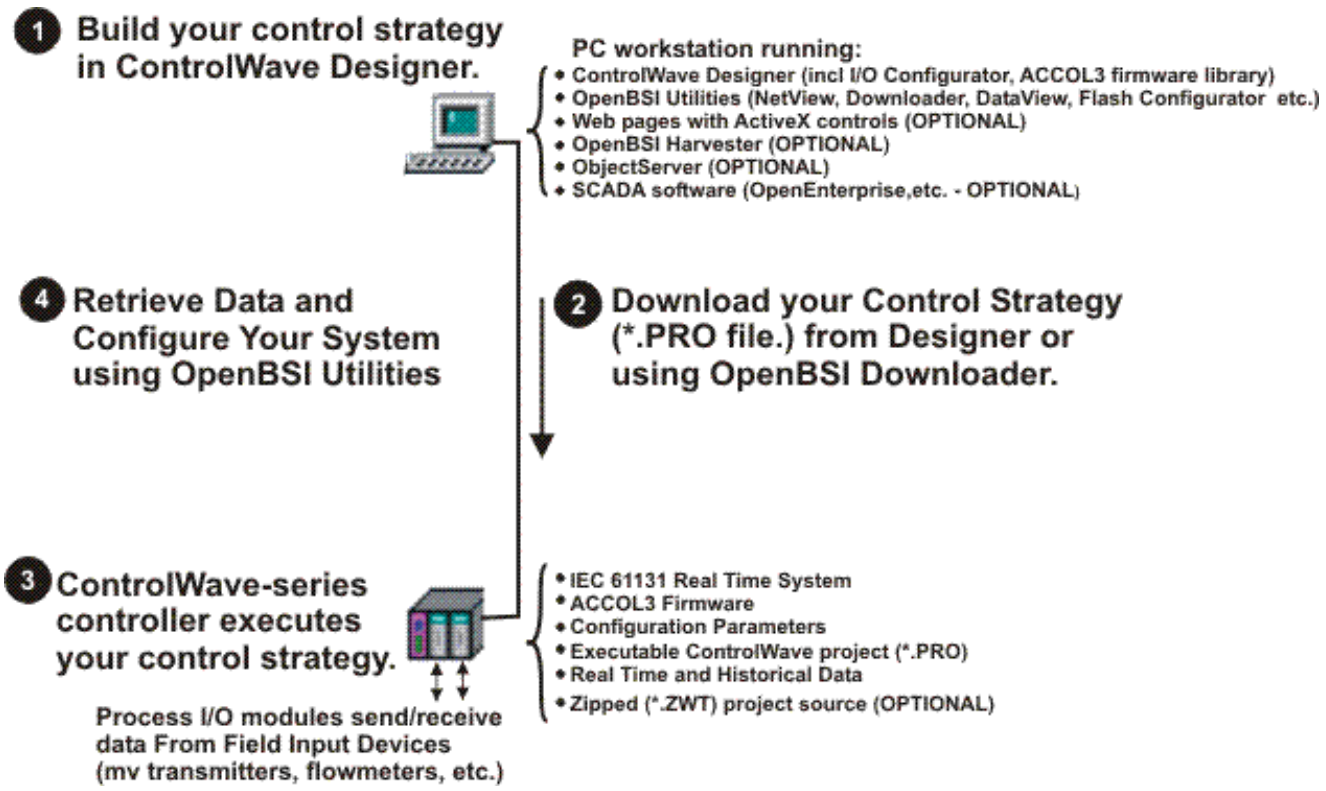
1 Build your control strategy in ControlWave Designer.
PC workstation running:
• ControlWave Designer (incl I/O Configurator, ACCOL3 firmware library)
• OpenBSI Utilities (NetView, Downloader, DataView, Flash Configurator etc.)
• Web pages with ActiveX controls (OPTIONAL)
• OpenBSI Harvester (OPTIONAL)
• ObjectServer (OPTIONAL)
• SCADA software (OpenEnterprise,etc. - OPTIONAL)
2 Download your Control Strategy (*.PRO file.) from Designer or using OpenBSI Downloader.
3 ControlWave-series controller executes your control strategy.
• IEC 61131 Real Time System
• ACCOL3 Firmware
• Configuration Parameters
• Executable ControlWave project (*.PRO)
• Real Time and Historical Data
• Zipped (*.ZWT) project source (OPTIONAL)
Process I/O modules send/receive data From Field Input Devices (mv transmitters, flowmeters, etc.)
4 Retrieve Data and Configure Your System using OpenBSI Utilities

Figure 1-8. ControlWave Programming Environment

The tools which make up the programming environment include:

- **ControlWave Designer** is your load-building package. It offers several different methods for you to create control strategy programs that run in your ControlWave Micro. You can use pre-made function blocks, ladder logic, or structured languages. The resulting process control strategy programs (called **projects**) are fully compatible with **IEC 61131** standards. For information on ControlWave Designer, see the *Getting Started with ControlWave Designer* manual (document D5085), the *ControlWave Micro Quick Setup Guide* (document D5124), and the *ControlWave Designer Programmer's Handbook* (document D5125).
- The **I/O Configurator**, accessible via a menu item in ControlWave Designer, allows you to define process I/O modules in the ControlWave and configure the individual mapping of I/O points for digital and analog inputs and outputs. For information on the I/O Configurator see the *ControlWave Designer Programmer's Handbook* (document D5125).

- The **ACCOL3 Firmware Library,** available within ControlWave Designer, includes a series of ControlWave-specific function blocks. These pre-programmed function blocks let you accomplish various tasks common to most user applications including alarming, historical data storage, as well as process control algorithms such as PID control. For information on individual function blocks, see the online help within ControlWave Designer.
- **OpenBSI Utilities** provides a set of programs that allow you to configure a communication network of ControlWave controllers, download files to the controllers, and collect data from the network. OpenBSI also exports data from the network to a SCADA/host package, such as **OpenEnterprise**. For information on configuring OpenBSI communications, see the *OpenBSI Utilities Manual* (document D5081).
- **OpenBSI Harvester** is a special add-on package that allows scheduled data collections from large networks. For information on the Harvester, see the *OpenBSI Harvester Manual* (document D5120).
- A series of **web page controls** are available for retrieval of real-time data values and communication statistics. These controls utilize ActiveX technology and are called through a set of fixed web pages, compatible with Microsoft® Internet Explorer. Alternatively, developers can place the controls in third-party ActiveX compatible containers such as Visual BASIC or Microsoft® Excel. For information on the ActiveX controls, see the *Web_BSI Manual* (document D5087).
- **User-defined web pages** - If desired, you can use the ActiveX web controls in your own user-defined web pages you can store at the PC to provide a customized human-machine interface (HMI).
- **Flash Configuration Utility** – Parameters such as the BSAP local address, IP address, etc. are set using the Flash Configuration Utility, accessible via OpenBSI LocalView, NetView, or TechView. For information on the Flash Configuration Utility, see *Chapter 5* of the *OpenBSI Utilities Manual* (document D5081).

Communication Protocols

In addition to the **Bristol Synchronous/Asynchronous Protocol (BSAP)**, ControlWave supports communications using:

Internet Protocol (IP) - You can use an Ethernet port or use a serial port using serial IP using **Point-to-Point Protocol (PPP)**.

Other supported protocols include: Modbus, Allen-Bradley DF1, CIP, DNP3, and Hex Repeater. See the ControlWave Designer online help for details and restrictions.

Chapter 2 – Installation

This chapter discusses the physical configuration of the ControlWave Micro, considerations for installation, and instructions for setting switches and jumpers on the CPU, PSSM, and ECOM modules.

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2.1 Site Considerations

When choosing an installation site, check all clearances. Ensure that the ControlWave Micro is accessible for wiring and service.

Caution

To ensure safe use of this product, please review and follow the instructions in the following supplemental documentation:

- **Supplement Guide - ControlWave Site Considerations for Equipment Installation, Grounding, and Wiring (S1400CW)**
- **ESDS Manual – Care and Handling of PC Boards and ESD Sensitive Components (S14006)**

Specifications for Temperature, Humidity and Vibration

- See document CWMICRO available on our website for detailed technical specifications for temperature, humidity, and vibration for the ControlWave Micro. This document is available on our website at: **http://www.emersonprocess.com/remote/D301671X012.pdf.**
- Ensure that the ambient temperature and humidity at the installation site remains within these specifications. Operation beyond the specified ranges could cause output errors and erratic performance. Prolonged operation under extreme conditions could also result in failure of the unit.
- Check the mounted enclosure, panel, or equipment rack for mechanical vibrations. Make sure that the ControlWave Micro is not exposed to a level of vibration that exceeds that provided in the technical specifications.

⚠ Caution

Placement of the ControlWave Micro in Class 1, Division 2 (Group A, B, C, and D) hazardous locations requires that you select an appropriate enclosure that meets NEMA Type 3X or 4X specifications.

2.1.1 Class I, Div 2 Installation Considerations

Underwriters Laboratories (UL) lists the ControlWave Micro as non-incendive and suitable **only** for use in Class I, Division 2, Group A, B, C, and D hazardous locations and non-hazardous locations. Read this chapter and *Appendix A* carefully before you install a ControlWave Micro in a hazardous location.

Perform all power and I/O wiring in accordance with Class I, Division 2 wiring methods as defined in *Article 501-4 (b)* of the *National Electrical Code, NFPA 70* (for installations within the United States) or as specified in *Section 18-152* of the *Canadian Electrical Code* (for installation in Canada).

⚠ WARNING

EXPLOSION HAZARD

Substitution of components may impair suitability for use in Class I, Division 2 environments.

When the ControlWave Micro is situated in a hazardous location, turn off power before servicing or replacing the unit and before installing or removing I/O wiring.

Do not disconnect equipment unless the power is switched off or the area is known to be non-hazardous.

2.2 Installation Overview

Installing a ControlWave Micro involves several general steps:

1. Unpacking, assembling, and configuring the hardware

2. Installing PC-based software (ControlWave Designer)
3. Establishing communications
4. Creating an application-specific control strategy (ControlWave project).
5. Creating application-specific web pages (optional)
6. Adding the ControlWave Micro to an OpenBSI network
7. Downloading the application-specific ControlWave project into the ControlWave Micro

Note: Steps 2 through 7 require that you install and use ControlWave Designer software on your PC. This manual focuses on hardware installation and preparation. Software installation and configuration is beyond the scope of this manual. Refer to the *ControlWave Micro Quick Setup Guide* (D5124) for material related to software installation and use.

2.2.1 Unpacking Components

Packaging

Depending upon how you order it, the ControlWave Micro may arrive pre-assembled, or in a number of separate boxes. If you did not order it pre-assembled, you must identify, unpack, and assemble the components. Unless otherwise noted, you can place modules in any slot in a base or expansion housing.

Note: Do **not** install modules in the base or expansion housings until you have mounted and grounded those housings at the designated installation site.

Delivered boxes may include:

- Housing assemblies (3-, 4- or 8-slot base housings and 2-, 4-, or 8-slot expansion housings)
- Power Supply/Sequencer module (PSSM)

  Note: The PSSM must reside in slot #1 in the base housing.

- CPU module

  Note: The CPU module must reside in slot #2 in the base housing.

- Expansion Communication Module (ECOM).

  Note: The first ECOM must reside in slot #3 in the base housing; a second ECOM can reside in slot #4 in the base housing.

- I/O Modules

  Note: There are many different types of I/O modules available. *Chapter 3* contains detailed instructions on each I/O module.

- One or more bezel assemblies; each bezel covers two I/O modules.

Housing

The base housing (or chassis) for the ControlWave Micro is an open-faced aluminum assembly. In use, you install a blue plastic cover ("bezel") over each pair of installed I/O modules, as shown in *Figure 2-1*.).

Figure 2-1. 8-Slot Base Housing with Bezel

Keyed cutouts in the housing's rear wall (see *Figure 2-2* through *Figure 2-7*) permit wall or panel mounting. The base housing has the following components:

- Built-in guides on the top and bottom of the housing permit easy installation and removal of modules
- Built-in ground lug (on right bottom corner of housing)
- Printed circuit board (PCB) attached to interior back of housing provide seating and electrical interface for modules
- Built-in interface connector (available only on 4-slot and 8-slot housings) for expansion housings.

Composed of aluminum (plated with gold irridite), the base housing has three configurations (3-slot, 4-slot, or 8-slot backplane). Optional I/O expansion housings (also gold irridite-plated aluminum) accommodate additional I/O modules in three configurations (2-slot, 4-slot, or 8-slot backplanes), and can be either wall- or panel-mounted or rack mounted with a DIN-rail. Refer to *Figure 2-2* through *Figure 2-7* for dimensional drawings of the three base housings and three expansion housings.

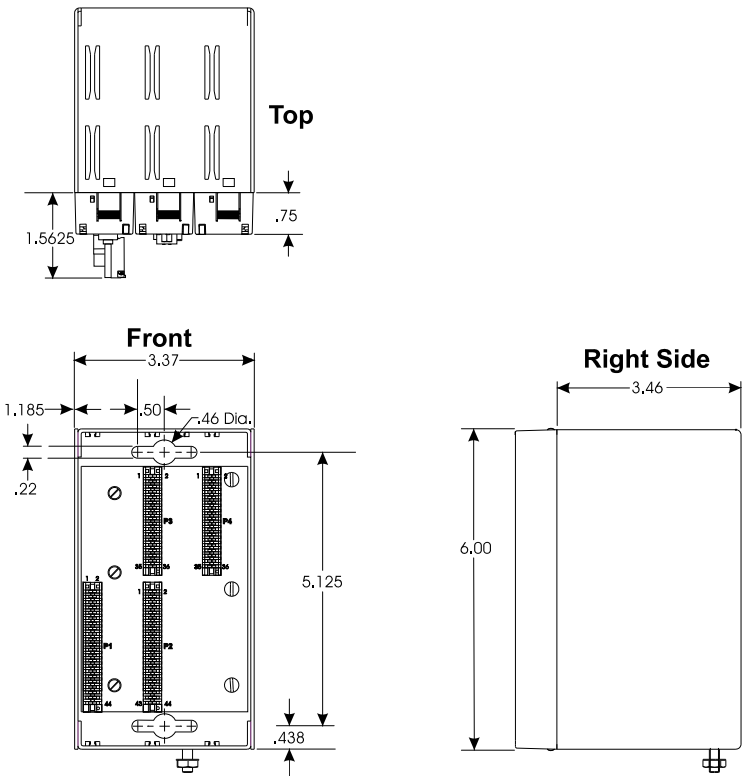

Figure 2-2. 3-Slot Base Housing

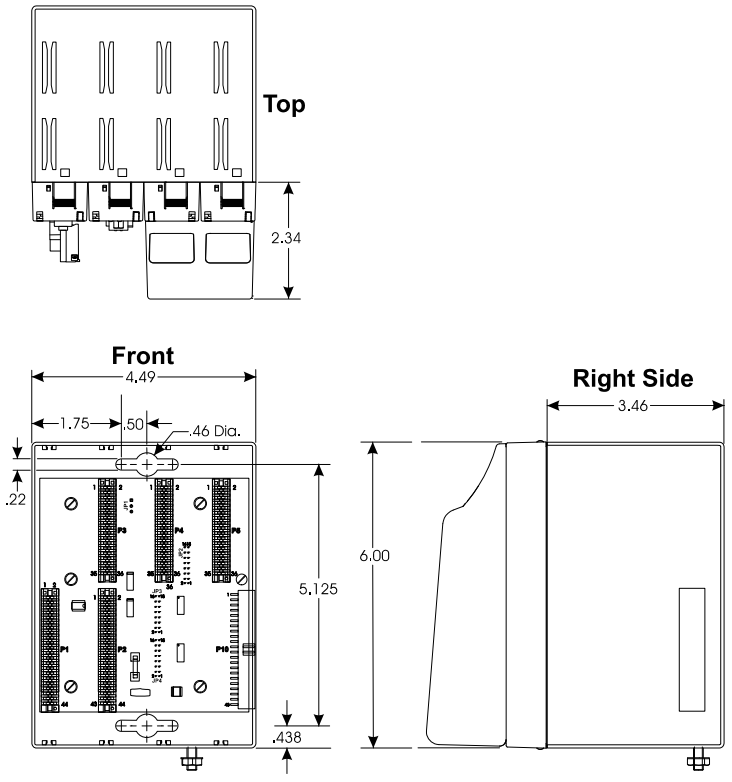

Figure 2-3. 4-Slot Base Housing

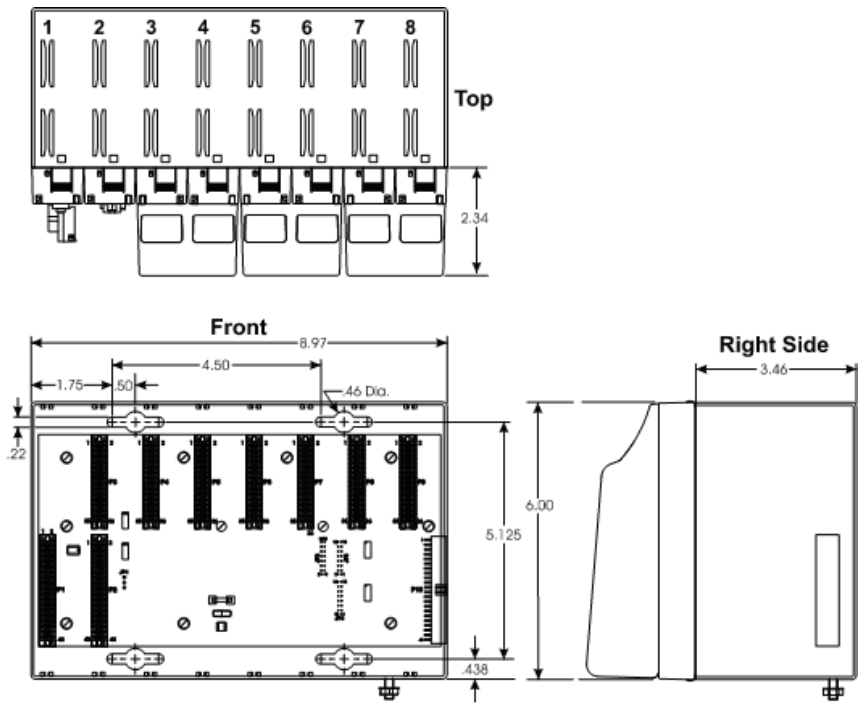

Figure 2-4. 8-Slot Base Housing

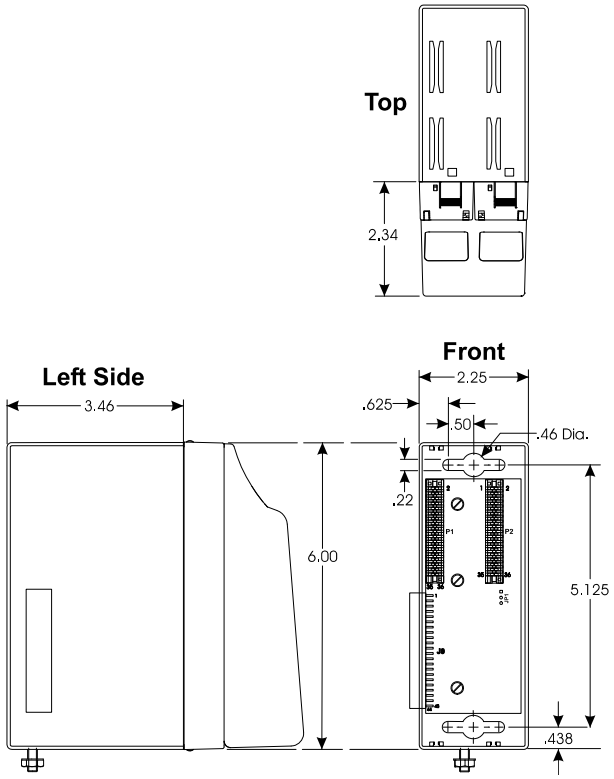

Figure 2-5. 2-Slot Expansion Housing

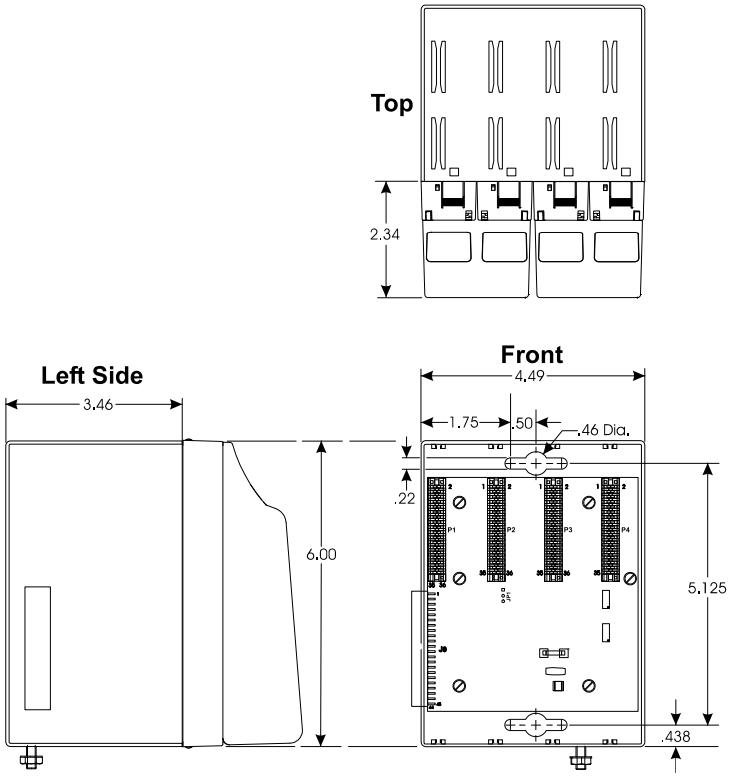

Figure 2-6. 4-Slot Expansion Housing

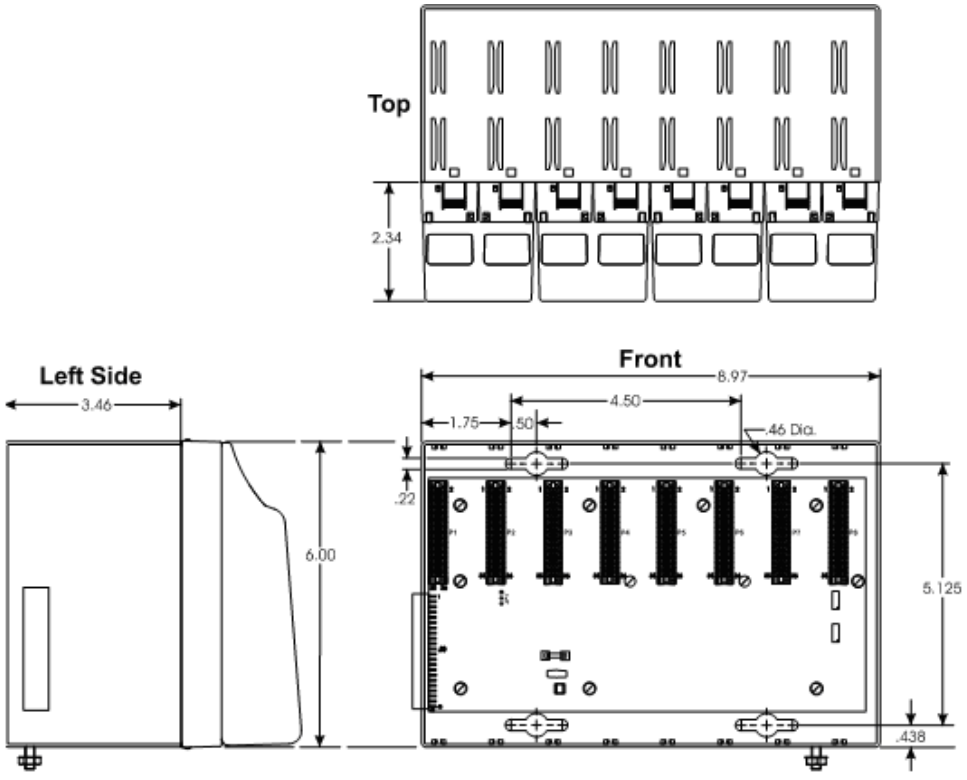

Figure 2-7. 8-Slot Expansion Housing

2.2.2 Mounting the Housing

You can mount base or expansion housings to a panel or a wall. When mounting one of these units to a panel or wall, place it according to the following guidelines:

- Ensure that the front of the ControlWave Micro is visible and accessible for service (for example, so you can easily install or remove modules).
- Use the mounting holes provided in the base and expansion housings (see *Figure 2-2* through *Figure 2-7).*

Remove the base housing and any applicable expansion housings from their cartons and install them at the assigned work site.

Note: If you are attaching an expansion housing to a 4-slot or 8-slot base housing, remove the three bus terminators JP2, JP3, and JP4 (see *Figure 2-8*) from the backplane on the 4-slot or 8-slot base housings. You also may need to remove the paper label over the connector on the right back edge of the base housing.

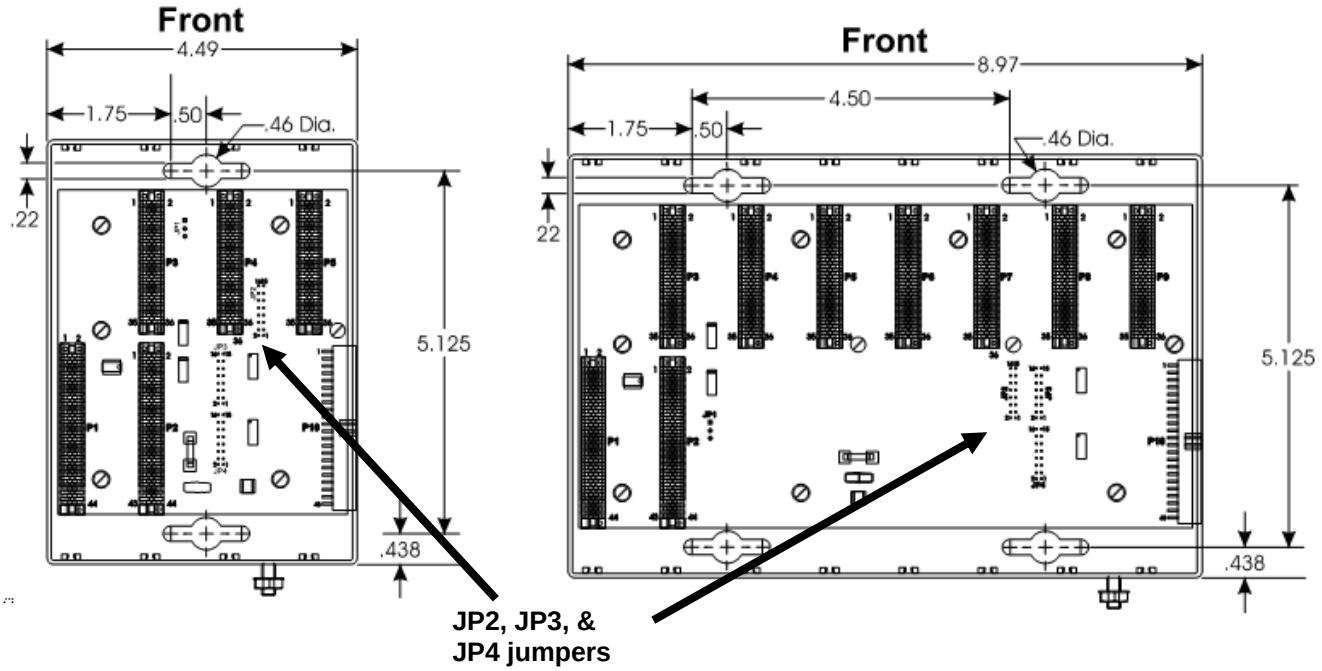

Figure 2-8. JP2, JP3, and JP4 Jumpers on Base Housing

Face the housings and mount the base housing on the left and the expansion housing on the right so that the connector on the right back edge of the base housing (P10) seats firmly with the connector on the left back edge of the expansion housing (P9).

2.2.3 Grounding the Housing

Caution **Do not install any modules in the base or expansion housings until you have mounted and grounded those housings at the designated installation site.**

Base housings have a ground lug (see *Figure 2-2* through *Figure 2-7*) that accommodates up to a #4 AWG wire size. Once you have installed the base and any expansion housings, you must run a ground wire between the base housing ground lug and a known good earth ground.

Note: After you install the PSSM in the base housing, as an added precaution we recommend that you run a #14 AWG wire from the TB1-3 power connection (Ground) to the same known good earth ground.

Additional grounding guidelines include:

- Use stranded copper wire (#4 AWG) for the base housing to earth ground, and keep the length as short as possible.
- Clamp or braze the ground wire to the ground bed conductor (typically a stranded copper AWG 0000 cable installed vertically or horizontally).
- Tin the wire ends with solder (using a high-wattage soldering iron) prior to inserting the wire into the base housing ground lug.
- Run the ground wire so that any routing bend in the cable has a minimum radius of 12-inches below ground and 8-inches above ground.

2.3 Power Supply/Sequencer Module (PSSM)

Before we actually configure the PSSM and install it in the housing, we're going to discuss some general information about how it works.

2.3.1 General Information about the PSSM

The Power Supply/Sequencer module (PSSM) plugs into slot #1 (first slot from the left) on the ControlWave Micro's backplane using connector P1, a 44-pin female non-keyed header (see *Figure* 2-2, *Figure 2-3* and *Figure 2-4*).

Currently, we offer the PSSM in two configurations:

- PSSM with Run/Remote/Local Switch & Display Interface (model 396657-01-0, Revision A and above) (see *Figure 2-9*)
- PSSM with Mode Switch SW1 & Display Interface (model 396657-02-8 without Watch Dog, Revision A and above) (see *Figure 2-10*)

Note: In addition to these two PSSM versions, you can optionally substitute a System Controller Module (SCM) for the PSSM. Since the SCM is designed primarily for use in ControlWave EFM models, we won't discuss the SCM in this manual. See *CI-ControlWave EFM* for more information on the SCM.

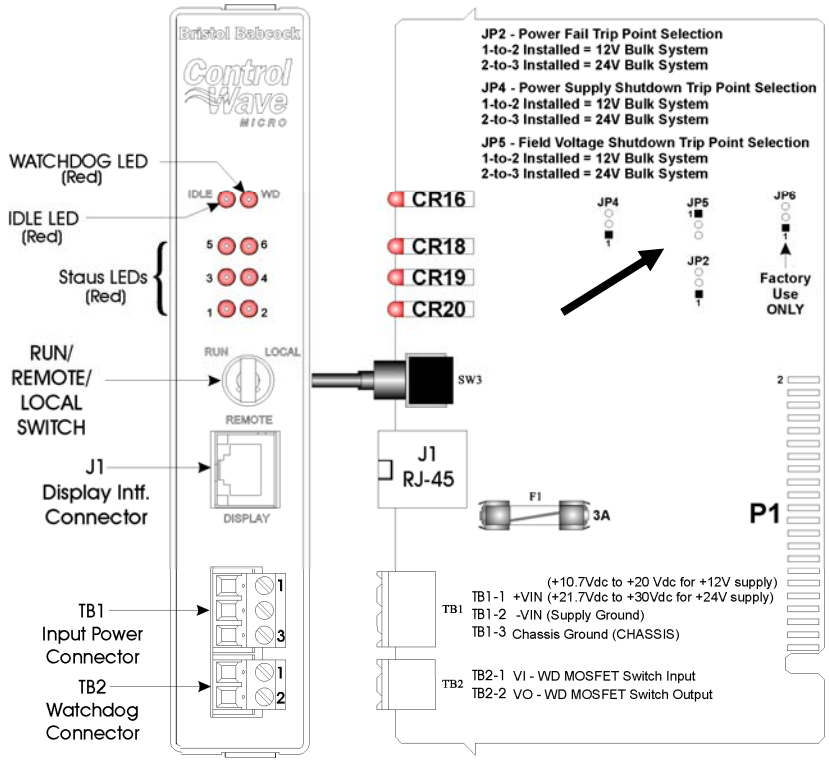

Figure 2-9. PSSM with Run/Remote/Local Switch, Display Interface, and Watchdog Connector

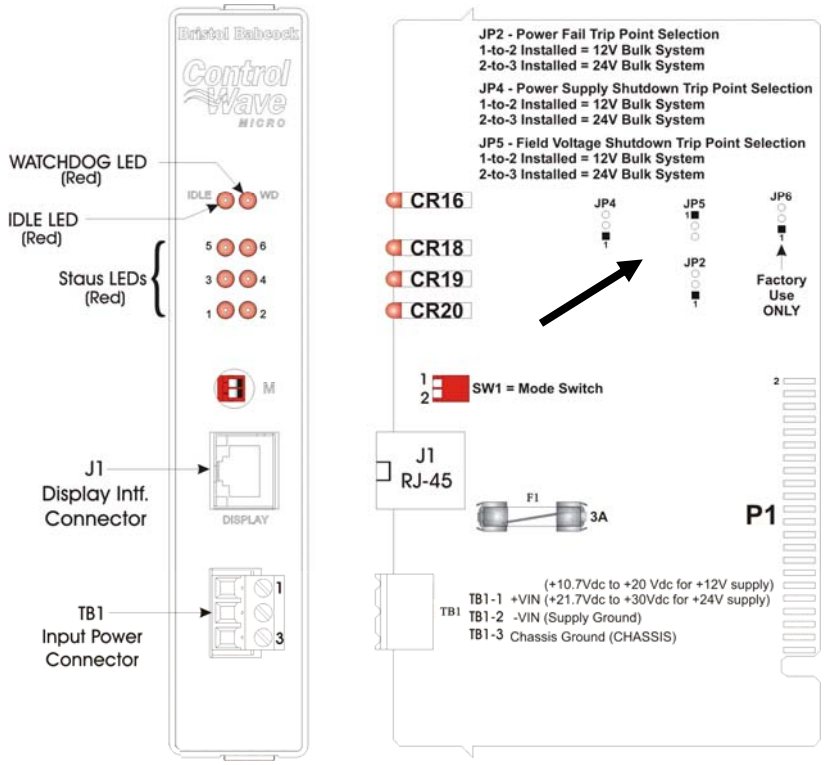

Figure 2-10. PSSM Module with Mode Switch, Display Interface, and without Watchdog Connector

Two terminal blocks (see *Figure 2-9*) provide external input power and watchdog connector switch connections. Two red LEDs on the PSSM's front panel enable you to monitor the status of the watchdog (WD) and Idle (IDLE) circuits.

Note: The Idle LED is usually on, indicating when the CPU has free time at the end of its execution cycle. If the LED is off, it indicates the CPU has no free time and may be overloading.

Six additional LEDs provide system status codes (see *Chapter 5)*.

PSSMs contain a DC-to-DC converter that generates a +3.3 Vdc supply for the entire unit (that is, the CPU and various I/O modules that plug into the backplane).

Power Supply

An auxiliary +5 Vdc regulator powers low power detection circuitry and sequencer timing circuitry.

The power supply operates from +10.7 to +30 Vdc or from +21.7 to +30 Vdc. You can configure the nominal input supply configuration (12V or 24V) using configuration jumper switches on the PSSM PCB. See *Figure 2-9* and *Figure 2-10*.

Watchdog Switch

PSSMs optionally include a watchdog metal oxide semiconductor field-effect transistor (MOSFET) switch connector. The purpose of the watchdog connector is to trigger an external alarm or annunciator if the ControlWave enters a "watchdog" condition in which the CPU cannot control your process. This occurs on power-up before the ControlWave project starts, if the unit is reset, if the ControlWave project "crashes" or if the system loses power. See *Section 2.3.7*.

2.3.2 PSSM Installation Overview

There are several steps you need to follow when you install the PSSM.

1. Identify the carton holding the PSSM and remove it from that carton. See *Section 2.2.1*.
2. Set jumpers on the PSSM based on whether your external DC bulk power supply provides +12V or +24V. See *Section 2.3.3*.
3. If your PSSM includes a mode switch (SW1) set it according to *Section 2.3.4*.
4. Slide the PSSM into slot #1 of the housing.
5. Unplug terminal block connector TB1 from the PSSM and wire it to an external bulk DC power supply. See *Section 2.3.6*.
6. If you want to use the watchdog connector TB2, unplug it from the PSSM and wire it to an external annunciator or similar device according to instructions in *Section 2.3.7*.
7. After you configure and install the CPU module in slot #2 re-connect terminal blocks to their connectors to apply power to the unit.

2.3.3 Setting Jumpers on the PSSM

The PSSM has three jumpers which you set based on whether your bulk DC power supply will provide +12V or +24V. See *Figure 2-9* or *Figure 2-10* to locate the jumpers on your version of the PSSM.

- **JP2**: Three-position Power Fail Trip Point Selection Jumper:
  - 1-to-2 Installed = Choose this to select +12V Bulk Supply Power Fail Trip Point
  - 2-to-3 Installed = Choose this to select +24V Bulk Supply Power Fail Trip Point (default)
- **JP4**: Three-position Power Supply Shutdown Trip Point Selection Jumper:
  - 1-to-2 Installed = Choose this to select +12V Bulk Supply Shutdown Trip Point.
  - 2-to-3 Installed = Choose this to select +24V Bulk Supply Shutdown Trip Point. (default)

- **JP5**: Three-position Field Voltage Shutdown Trip Point Selection Jumper
  - 1-to-2 Installed = +12V Bulk Supply Field Voltage Shutdown Trip Point Selected
  - 2-to-3 Installed = +24V Bulk Supply Field Voltage Shutdown Trip Point Selected. (default)

2.3.4 Setting Mode Switch SW1 on the PSSM

The version of the PSSM shown in *Figure 2-10* has a DIP switch that controls whether the PSSM operates in Local Mode or Recovery Mode.

Local Mode is the normal operating mode for the ControlWave Micro, and is the factory default. We recommend you use the factory default unless you have a reason to use Recovery Mode.

Only use Recovery Mode during system firmware upgrades or core updumps. See *Chapter 5* for more information on these subjects.

Table 2-1 lists the SW1 settings:

Table 2-1. PSSM Switch SW1

Switch position	Mode
Both switches set to right (Open) **or** both switches set to left (Closed)	Activates Recovery mode, used for firmware upgrades or core updumps.
Upper switch (SW-1) set to right (Open) and lower switch (SW-2) set to left (Closed)	Activates Local mode, used for normal operation. (This is the **factory default**)

Note: Only the PSSM SW1 switch settings listed in the table have been tested.

2.3.5 General Wiring Guidelines

- ControlWave Micro PSSMs use compression-type terminals that accommodate up to #14 AWG wire.
- When making a connection, insert the bare end of the wire (approx ¼" max) into the clamp adjacent to the screw and secure the wire.
- To prevent shorts, ensure that no bare wire is exposed. If using standard wire, tin the bare end with solder to prevent flattening and improve conductivity.
- Allow some slack in the wire while making terminal connections. Slack makes the wires more manageable and helps minimize mechanical strain on the terminal blocks.

2.3.6 Wiring a Bulk DC Power Supply to the PSSM

Caution

At this time you can also connect power and watchdog wiring. However; for safety reasons and to prevent accidental damage to the your bulk DC power supply, do not connect the pluggable terminal block connectors TB1 and TB2 to the PSSM until after you install, wire, and configure the CPU module.

Follow the instructions in *Section 2.3.5 General Wiring Guidelines* when wiring connections.

You can connect one bulk DC power supply (nominally either +12 Vdc or +24 Vdc) to the PSSM. The PSSM then converts, regulates, and filters the power to +3.3 Vdc. For safety, the PSSM circuit has a 3A fuse.

The ControlWave Micro PSSM's operating range is +10.7 to +30.0 Vdc (with nominal +12Vdc input source) or +21.7 to +30.0 Vdc (with a nominal +24Vdc input source).

Use the following formula to determine the maximum current required for the +12 Vdc or +24 Vdc bulk power used with a particular ControlWave Micro:

Bulk + 12/24 Vdc Supply Current = CPU* + Sum of all ECOM modules and I/O modules.

Refer to *Table 2-2* for ControlWave Micro bulk power requirements.

Table 2-2. Bulk Power Requirements

Component	Bulk 24 Vdc Power Supply	Bulk 12 Vdc Power Supply
CPU, backplane, and PSSM (with Ethernet)	50 mA	100 mA
CPU, backplane, and PSSM (without Ethernet)	45 mA	90 mA
Any backplane	2 mA	4 mA
PSSM	3.2 mA	6.4 mA
Non-isolated AI/AO Module	2.8 mA + (47.2 mA – VEXT)	5.6 mA + (47.2 mA – VEXT)
Isolated DI Module	104 mA	208 mA
Isolated DO Module	13 mA	26 mA
Non-isolated DI/DO Module	12 mA	24 mA
Non-isolated HSC Module	5 mA	10 mA
Isolate5.3 mA d AI Module	113 mA + (24.5 mA/loop)	192 mA + (49 mA/loop)
Isolated AO Module	10 mA + (22.5 mA/I loop) or 10 mA + (5.3 mA/E loop @ 5 mA)	19 mA + (45 mA/I loop) or 19 mA + (10.5 mA/E loop @ 5 mA)
Non-isolated Mixed I/O module (with optional AO)	8.3 mA + (24.3 mA – VEXT)	16.67 mA + (24.3 mA – VEXT)
Isolated VAC DI module	5 A	10 mA
Isolated VAC/DC DO module	10 mA	20 mA
Isolated DI/DO module	83.1 mA	166.2 mA

Component	Bulk 24 Vdc Power Supply	Bulk 12 Vdc Power Supply
HART/BTI module	250 mA	500 mA
Isolated RTD module	13.5 mA	27 mA
Isolated LLAI module	26.3 mA	52.5 mA
ECOM without modem/radio	22 mA	45 mA
ECOM with modem	56 mA	112 mA
ECOM with FreeWave radio*	272 mA	545 mA
ECOM with modem and FreeWave radio*	306 mA	612 mA

* FreeWave radio no longer available

Terminal Block Connector TB1

Unplug removable connector TB1 from the PSSM and wire DC power to the connector. We recommend you do **not** plug the connector back into the PSSM until the CPU module is already installed in the housing.

TB1 provides three input connections for bulk power:

- TB1-1: (+VIN) (+10.7V to +30V dc for +12V supply) (+21.7V to +30V dc for +24V supply)
- TB1-2 = (-VIN) (Supply Ground - PSGND)
- TB1-3 = Chassis Ground - CHASSIS (⏚)

Figure 2-11 shows the typical wiring at the PSSM's TB1 block.

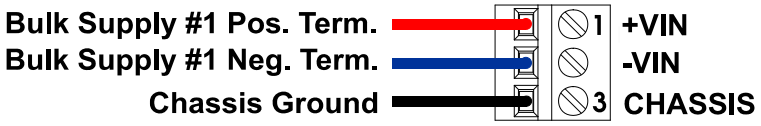

Figure 2-11. PSSM TB1 Wiring

Note: As an added precaution, we recommend that you run a #14 AWG wire from the TB1-3 power connection (Ground) to the same known good earth ground used for the base housing.

2.3.7 Wiring an External Alarm or Annunciator to the Watchdog Connector (OPTIONAL)

Caution

At this time you can also connect power and watchdog wiring. However; for safety reasons and to prevent accidental damage to the your bulk DC power supply, do not connect the pluggable terminal block connectors TB1 and TB2 to the PSSM until after you install, wire, and configure the CPU module.

Follow the instructions in *Section 2.3.5 General Wiring Guidelines* when wiring connections.

The version of the PSSM shown in *Figure 2-9* includes an optional watchdog connector. The purpose of the watchdog connector is to

trigger an external alarm or annunciator if the ControlWave Micro enters a "watchdog" condition in which the CPU cannot control your process.

A watchdog condition occurs when:

- A watchdog timer expires. This happens if the ControlWave project execution halts unexpectedly – "program crash."
- The controller powers up but is not yet running the ControlWave project.
- The CPU module detects that the regulated 3.3 Vdc or 1.8 Vdc supplies are out of specification.

A MOSFET switch activates the watchdog connector whenever a watchdog condition occurs.

Terminal Block Connector TB2

You must power the watchdog connector (TB2) from an external power supply. Unplug removable connector TB2 from the PSSM and wire power to the connector. We recommend you do **not** plug the connector back into the PSSM until the CPU module is already installed in the housing.

TB2 provides two watchdog MOSFET switch connections:

- TB2-1 = VI - Watchdog MOSFET Switch Input
- TB2-2 = VO - Watchdog MOSFET Switch Output

The VI input on TB2 powers the watchdog switch; its switched output connects to the VO output on the same terminal block. You must reference the external power source connected to the VI terminal to the return point of the input source powering the PSSM (which is either – VIN or PSGND on TB2). See *Figure 2-12*.

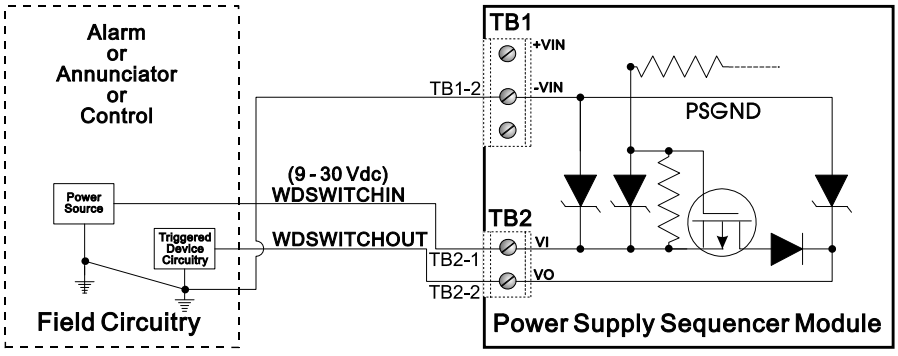

Figure 2-12. Watchdog MOSFET Switch Wiring

2.4 CPU Module

The CPU module, which controls the ControlWave Micro and handles memory and communication functions, can only be installed in Slot #2 of the ControlWave Micro backplane.

Note: Do not confuse the CPU module (which has communication components) with the Expansion Communication module (ECOM), which **does not** have a CPU component or a battery backup but **does** have additional communication components.

Identify the carton holding the CPU module and remove it from that carton. The CPU module has several different configurations, each of which have on-board communications components:

- CPU with two RS-232 serial ports, and one RS-485 serial port (see *Figure 2-13*)
- CPU with two RS-232 serial ports, one RS-485 serial port, and one Ethernet port (see *Figure 2-14*)
- CPU with one RS232 serial port, one RS-485 serial port, and two Ethernet ports (see *Figure 2-15*)

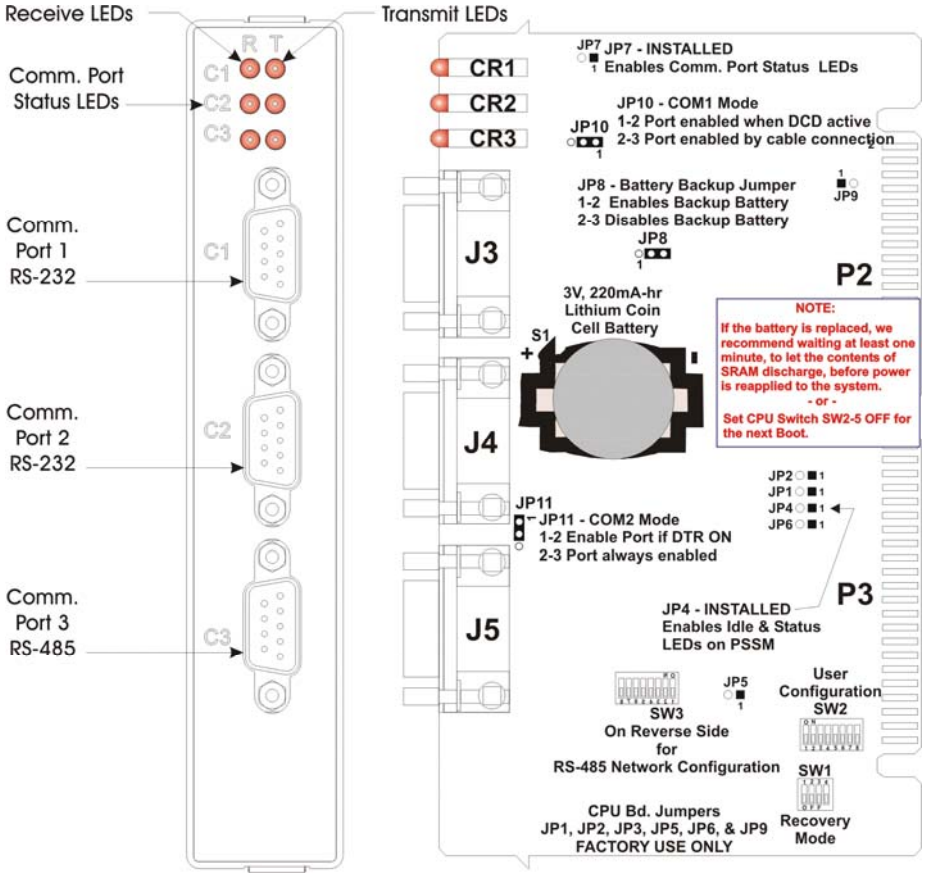

Figure 2-13. CPU Module with Three Serial Ports

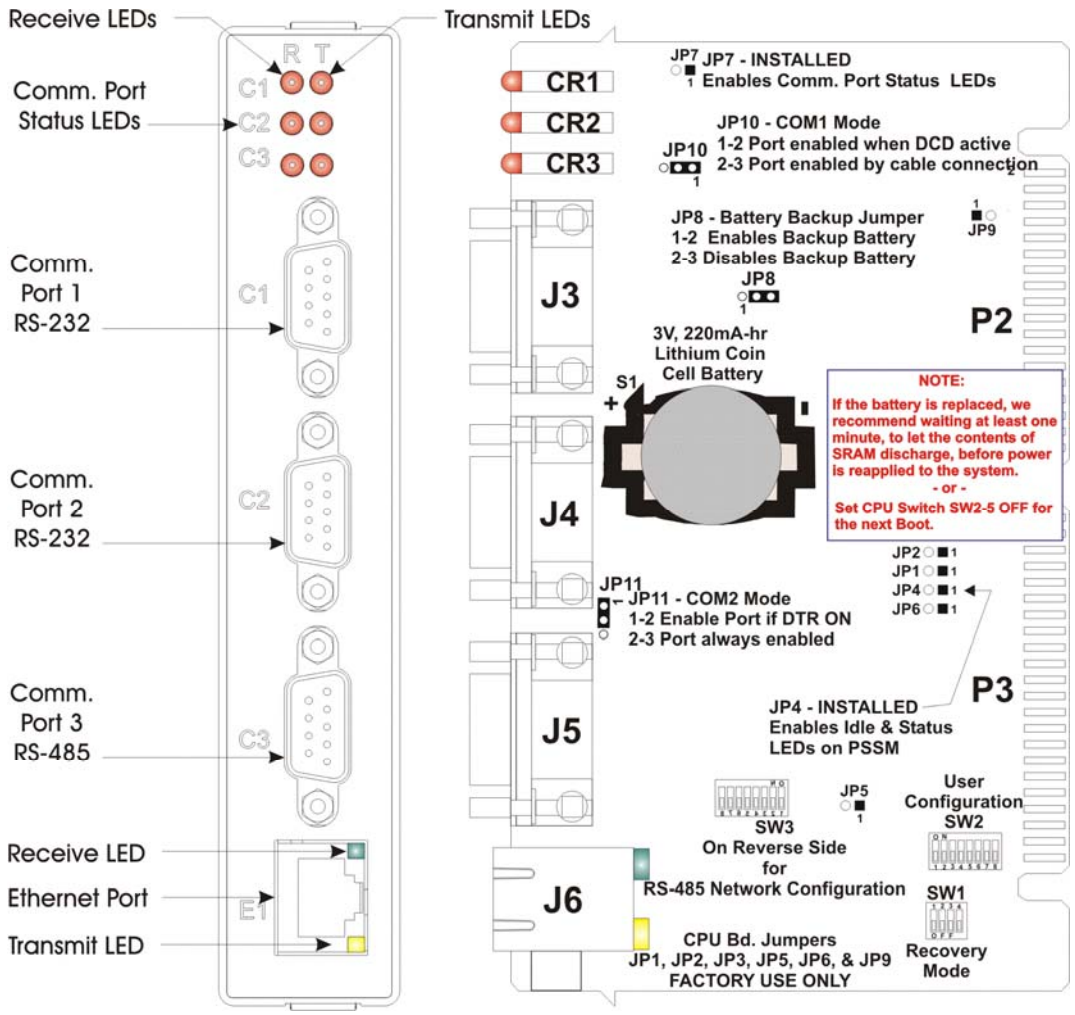

Figure 2-14. CPU Module with Three Serial Ports and One Ethernet Port

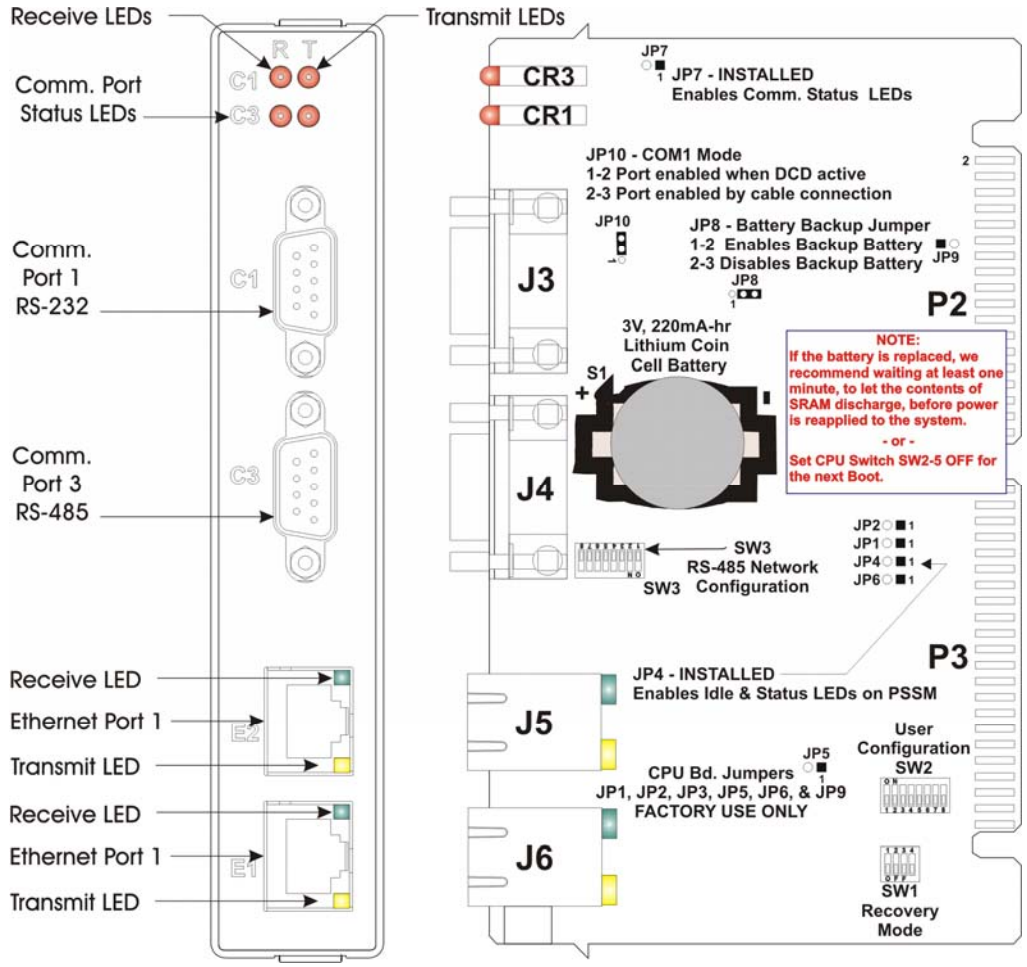

Figure 2-15. CPU Module with Two Serial and Two Ethernet Ports

2.4.1 Setting Jumpers on the CPU Module

Each CPU module contains a number of jumpers (labeled with JP*n*) when *n* in the jumper number. See *Figure 2-13*, *Figure 2-14*, or *Figure 2-15*) to locate the jumpers.

Note: When present, jumpers 1, 2, 3, 5, 6, and 9 (**JP1, JP2**, **JP3**, **JP5**, **JP6,** and **JP9**) are reserved for factory use only. **Do not alter these jumpers from their factory settings**.

- Jumper 4 (**JP4**) enables the Idle and Status LEDs on the PSSM. It comes enabled from the factory. (We recommend you leave these LEDs enabled during initial installation and setup. If power conservation is an issue, you can disable these LEDs by removing the jumper.)
- Jumper 7 (**JP7**) enables the Communication Port Status LEDs on the CPU module. It comes enabled from the factory. We recommend

you leave these LEDs enabled during initial installation and setup. If power conservation is an issue, you can disable these LEDs by removing the jumper.

Note: For maximum shelf life, the CPU module ships from the factory with the installed lithium backup battery disabled. You must enable it when you install the CPU module by placing JP8 on pins 1-2.

- Jumper 8 (**JP8**) enables/disables the lithium backup battery on the CPU module.
  - Pins 1-2: Enables the CPU module's backup battery.
  - Pins 2-3: Disables the CPU module's backup battery (**Factory default**)
- Jumper 10 (**JP10**) specifies how COM1 is enabled.
  - Pins 1-2: Enables COM1 whenever DCD is active. (**Factory default**)
  - Pins 2-3: Enables COM1 whenever you connect a cable to the port.
- Jumper 11 (**JP11**) when present, specifies how COM2 is enabled.
  - Pins 1-2: Enables COM2 whenever DTR is ON. (**Factory default**)
  - Pins 2-3: Port is always enabled. This setting can be used to control external radios that feature DTR sleep modes.

2.4.2 Setting DIP Switches on the CPU Module

Before you install the CPU module, you must determine the settings for three banks of DIP switches. Refer to *Figure 2-13, Figure 2-14,* or *Figure 2-15* for the location of the DIP switch banks on each CPU module. Refer to *Tables 2-3* through *2-5* for DIP switch setting values.

Note: Examine each bank of DIP switches carefully to note the switch direction for ON or OFF.

Table 2-3. CPU Module Switch SW1

SW1 Setting	Function	Mode
1	N/A	Not currently used.
2	N/A	Not currently used.
3	Force Recovery Mode	Enables recovery mode. Values are: **ON** (enables recovery mode) **OFF** (disables recovery mode). – This is the **factory default**.
4	N/A	Not currently used.

Table 2-4. CPU Module Switch SW2

SW2 Setting	Function	Mode
1	Watchdog Enable	Controls whether the system enters a watchdog state when a crash or system hangup occurs and automatically restarts. Values are: **ON** (Enables watchdog circuit; **factory default**) **OFF** (Disables watchdog circuit and prevents automatic restart)
2	Lock/Unlock Soft Switches	Controls the ability to modify soft switches, other configurations, and flash files. Values are: **ON** (Unlocks soft switches and flash files; **factory default**). **OFF** (Locks soft switches, configurations, and flash files)
3	Use/Ignore Soft Switches	Controls the use of soft switches. Values are: **ON** (Enable user-defined soft switches configured in flash memory; **factory default**) **OFF** (Disable soft switch configuration and use factory defaults) **Note**: Setting both switch 3 and switch 8 to **OFF** (closed) sets all serial communication ports to 9600 bps operation. All serial communication ports must be set at 9600 bps before WINDIAG can perform communication tests.
4	Core Updump	Causes the ControlWave Micro to perform a core updump, provided you have set the PSSM mode switch to Recovery mode or properly sequenced the Run/Remote/Local switch on the PSSM. Values are: **ON** (Disables core updump; **factory default**) **OFF** (Core updump via PSSM Run/Remote/Local switch or PSSM mode switch SW1)
5	SRAM Control	Manages SRAM contents following a low power situation or a power outage. Values are: **ON** (Retain values in SRAM during restarts; **factory default**) **OFF** (Reinitialize SRAM) – Data in SRAM lost during power outage or re-start.
6	System Firmware	Allows a remote download of system firmware (on units equipped with boot PROM version 4.7 or higher and system PROM version 4.7 and higher). Values are: **ON** (Enable remote download of system firmware; **factory default**) **OFF** (Disable remote download of system firmware)
7	N/A	Not currently used.

SW2 Setting	Function	Mode
8	Enable WINDIAG	Suspends normal operation and allows diagnostic routines. Values are: **ON** (Permits normal system operation, including the boot project, and disables the WINDIAG diagnostics from running; **factory default**) **OFF** (Allow WINDIAG to run test; disable boot project and normal system operation.) **Note**: Setting both switch 8 **and** switch 3 to **OFF** (closed) sets all communication ports to 9600 bps operation. All serial communication ports must be set at 9600 bps before WINDIAG can perform communication tests.

Notes:

- *Table 2-5* describes switch settings for the RS-485 port. You may want to review *Section 2.4.4 Connections to RS-485 Serial Port(s)* before you set these switches.
- *Table 2-5* applies to the following switches:
  - SW3 on CPU Module – controls COM3
  - SW1 on Type 1 ECOM Module – controls COM5/COM9
  - SW1 on Type 2 ECOM Module – controls COM6/COM10
  - SW2 on Type 2 ECOM Module – controls COM7/COM11

Table 2-5. RS-485 Configuration Switch

Switch Setting	Function	Mode
1	TX+ to RX+ Loopback	**ON** (only for diagnostics or 2-wire)
2	TX- to RX- Loopback	**ON** (only for diagnostics or 2-wire)
3	100 Ohm RX+ Termination	**ON** (End nodes only)
4	100 Ohm RX- Termination	**ON** (End nodes only)
5	N/A	Not currently used
6	Slew Rate (ISO485 Only)	**ON** (Slow rate enabled) **OFF** (Fast rate enabled) **Note**: On CPU module, not currently used.
7	RX+ Bias (End Node)	**ON** (End nodes only)
8	RX- Bias (End Node)	**ON** (End nodes only)

After you configure the jumpers and DIP switches, slide the CPU module into slot #2 (the second slot from the left) of the base housing (see *Figure 2-2*, *Figure 2-3* or *Figure 2-4*).

2.4.3 Connections to RS-232 Serial Port(s) on CPU or ECOM Modules

An RS-232 port provides point-to-point, half-duplex and full-duplex communications (for a maximum of 20 feet using data quality cable).

Your CPU module includes either one or two RS-232 ports.

If you require additional RS-232 ports, you can purchase an optional expansion communication module that can include either one (ECOM Type 1) or two (ECOM Type 2) RS-232 ports. The ControlWave Micro can support up to two expansion communication modules, for a total of up to four additional RS-232 ports beyond those on the CPU module. Expansion communication modules reside in slot #3 and slot #4.

RS-232 COM Port Names and Connectors

RS-232 COM ports are assigned names based on their location in the ControlWave Micro.

- If the CPU module has two RS-232 ports and one RS-485 port (as in *Figure 2-13*), the RS-232 ports are COM1 and COM2.
- If the CPU module has one RS-232 port and one RS-485 port (as in *Figure 2-15*), the RS-232 port is COM1.

Table 2-6. RS-232 Connectors on CPU

Connector	Name	# Pins	Function	Notes
J3	COM1	9-pin	9-pin male D-sub (RS-232)	See *Figure 2-13*, *Figure 2-14* *Figure 2-15*, *Figure 2-16* & *Table 2-8*
J4	COM2	9-pin	9-pin male D-sub (RS-232)	See *Figure 2-13*, *Figure 2-14* *Figure 2-16* & *Table 2-8*

- If you have an ECOM module with one RS-232 port, this is COM4 if the module is in slot #3 or COM8 if the module is in slot #4.
- If you have an ECOM module with two RS-232 ports, those ports are COM4 and COM5, respectively, if the ECOM module is in slot #3, or COM8 and COM9, respectively, if the ECOM module is in slot #4.

Table 2-7. RS-232 Connectors on Expansion Communications Modules

Connector	Name	# Pins	Function	Notes
J4	COM4 (when in slot 3) COM8 (when in slot 4)	9-pin	9-pin male D-sub (RS-232)	See *Figure 2-16, Figure 2-23, Figure 2-24* & *Table 2-8*
J5	COM5 (when in slot 3) COM9 (when in slot 4)	9-pin	9-pin male D-sub (RS-232)	See *Figure 2-16, Figure 2-24* & *Table 2-8* Only available on ECOM Type 2 models.

RS-232 COM Port Cables

For the ControlWave Micro, half-duplex communications use Modbus or BSAP protocol, while full-duplex communications use point-to-point protocol (PPP). RS-232 ports use a "null modem" cable (see *Figure 2-17*) to connect with other devices (such as a PC, a printer, another ControlWave [except the CW_10/30/35]) when the ControlWave Micro uses the full-duplex PPP protocol.

Note: You can configure the ControlWave Micro as either a master or slave node on a Modbus or BSAP network.

Figure 2-16 illustrates the CPU module's male 9-pin D-type connector. Use the content provided in *Table 2-8* to determine pin assignments for the COM1 and COM2 ports and the expansion communication ports COM4/5 and COM8/9.

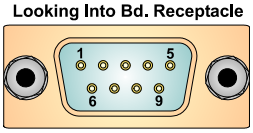

Figure 2-16. Male DB9 9-Pin Connector

Table 2-8. RS-232 Port Connector Pin Assignment

Pin	RS-232 Signal	RS-232 Description
1	DCD	Data Carrier Detect Input
2	RXD	Receive Data Input
3	TXD	Transmit Data Output
4	DTR	Data Terminal Ready Output
5	GND	Signal/Power Ground
6	DSR	Data Set Ready Input
7	RTS	Request to Send Output
8	CTS	Clear to Send Input
9		N/A

Use the "null modem" cable for full-duplex (PPP protocol) communications when connecting a ControlWave Micro to a PC. (See top part of *Figure 2-17*.)

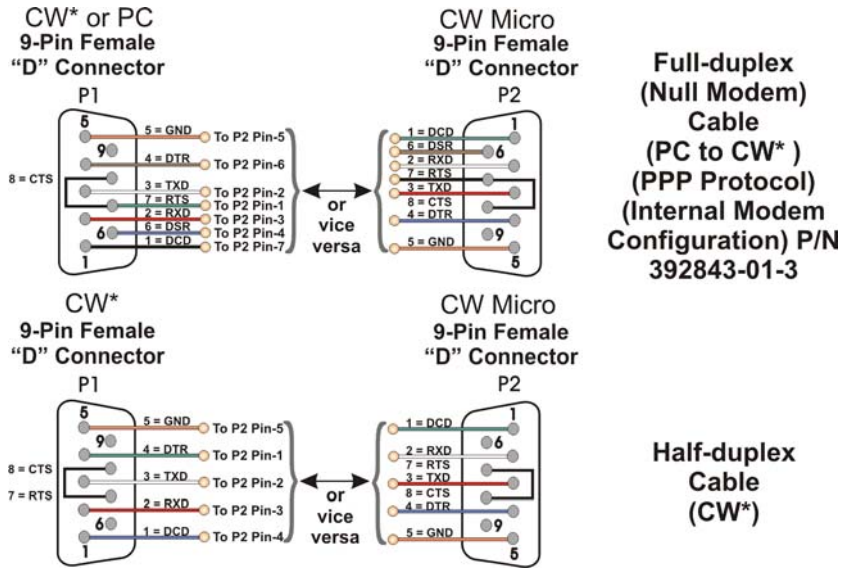

Figure 2-17. Full-duplex and Half-duplex Cable

Use the half-duplex cable (shown in the bottom part of *Figure 2-17*) when connecting the ControlWave Micro to another ControlWave series unit (again, with the exception of the CW_10/30/35).

When communicating with a Network 3000 series RTU 3305, RTU 3310, DPC 3330, or DPC 3335 or CW_10/30/35, you must use one of the cables shown in *Figure 2-18*.

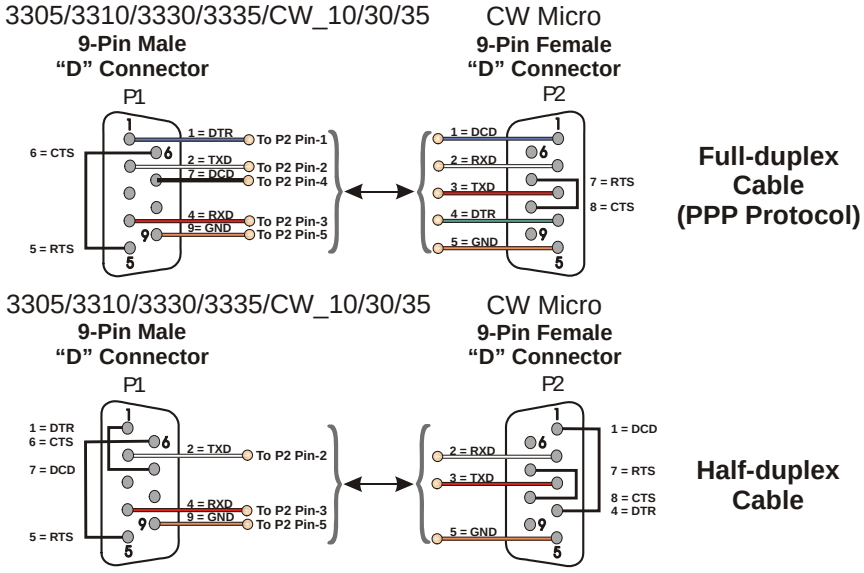

Figure 2-18. Full-duplex and Half-duplex Cable

When interfacing to the COM3 port of a ControlWave, or the COM5 or COM6 port a ControlWaveEXP unit, use the cable presented in *Figure 2-19* along with the cable shown in *Figure 2-17* or *Figure 2-18*.

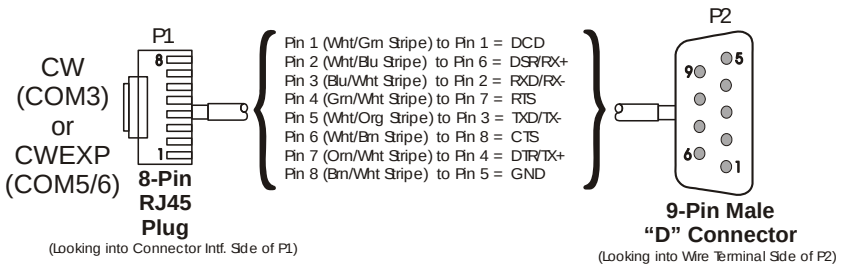

Figure 2-19. Full-duplex and Half-duplex Cable

RS-232 Cable Guidelines

Observe the following guidelines when constructing RS-232 communication cables:

- Ensure that DCD is high to transmit (except when dialing a modem)
- Verify that each RS-232 transceiver has one active receiver while disabled (in power down mode); connect the DCD signal to the active receiver.
- Set CTS to high to transmit.
- If the port is set for full-duplex operation, RTS is always ON.
- Ensure that DTR is always high when port is active; DTR enables RS-232 transceivers.

> **Note**: Control DTR using the PORTCONTROL function block and the _P*n*_AUTO_DTR system variable in your ControlWave project. If you turn DTR off through these mechanisms, the port remains off, even though hardware is fully configured.

- When port is set for half-duplex operation, CTS must go low after RTS goes low.
- All RS-232 comm ports support RTS, DTR, CTS, DCD, and DSR control signals.
- All RS-232 comm port I/O signals are protected by surge protectors.

2.4.4 Connections to RS-485 Serial Port(s) on CPU or ECOM Modules

The RS-485 port supports local network communications to multiple nodes up to 4000 feet away.

Your CPU module includes one RS-485 port.

If you require additional RS-485 ports, you can purchase an optional expansion communication module that includes one or two RS-485 ports. The ControlWave Micro can support up to two expansion communication modules, for a total of up to four additional RS-485 ports beyond the one on the CPU module. Expansion communication modules reside in slot #3 and slot #4.

RS-485 COM Port Names and Connectors

RS-485 COM ports are assigned names based on their location in the ControlWave Micro.

- The CPU module's RS-485 port is COM3.
- If you have a Type 1 ECOM module in slot #3, its RS-485 port is COM5. If you have a Type 1 ECOM module in slot #4, its RS-485 port is COM9.
- If you have a Type 2 ECOM module in slot #3, its RS-485 ports are COM6 and COM7. If you have a Type 2 ECOM module in slot #4, its RS-485 ports are COM10 and COM11.

Table 2-9 provides the connector assignments for CPU port COM3; *Table 2-10* shows the assignments for ECOM1 port COM5/9; and *Table 2-11* shows assignments for ECOM2 ports COM6/10 and 7/11.

Table 2-9. RS-485 Connectors on CPU

Connector	Name	# Pins	Function	Notes
J4 or J5 depending on CPU type	COM3	9-pin	9-pin male D-sub (RS-485)	See *Figure 2-13* (connector J5) or *Figure 2-15* (connector J4), and *Table 2-12.*

Table 2-10. RS-485 Connectors on Type 1 Expansion Communications Modules

Connector	Name	# Pins	Function	Notes
J5	COM5 (when in slot 3) COM9 (when in slot 4)	9-pin	9-pin male D-sub (RS-485)	See *Figure 2-23* & *Table 2-12* Only available on ECOM Type 2 models.

Table 2-11. RS-485 Connectors on Type 2 Expansion Communications Modules

Connector	Name	# Pins	Function	Notes
J6	COM6 (when in slot 3) COM10 (when in slot 4)	9-pin	9-pin male D-sub (RS-485)	See *Figure 2-24* & *Table 2-12*
J7	COM7 (when in slot 3) COM11 (when in slot 4)	9-pin	9-pin male D-sub (RS-485)	See *Figure 2-24* & *Table 2-12*

RS-485 COM Port Cables

Figure 2-16 illustrates the CPU module's male 9-pin D-type connector. Use the content provided in *Table 2-12* to determine pin assignments for the COM3 port on the CPU, and COM5/9, COM6/10, and COM7/11 expansion communication ports.

Table 2-12. RS-485 Port Connector Pin Assignment

Pin	RS-485 Signal	RS-485 Description
1		N/A
2	RXD–	Receive Data – Input
3	TXD–	Transmit Data – Output
4	TXD+	Transmit Data + Output
5	GND/ ISOGND	Ground/Isolated Ground
6	RXD+	Receive Data + Input
7		N/A
8		N/A
9		N/A

Since the RS-485 port is intended for network communications, refer to *Table 2-13* for the appropriate connections for wiring the master, first slave, and *nth* slave.

Essentially, the master and the first slave transmit and receive data on opposite lines; all slaves (from the first to the *nth*) are paralleled (daisy-chained) across the same lines. Wire the master node to one end of the RS-485 cable run using a 24-gauge paired conductor cable (such as a Belden 9843).

Note: ControlWave Micros support **only** half-duplex RS-485 networks.

Table 2-13. RS-485 Network Connections

From Master	To First Slave	To nth Slave
TXD+	RXD+	RXD+
TXD–	RXD–	RXD–
RXD+	TXD+	TXD+
RXD–	TXD–	TXD–
GND/ISOGND	GND/ISOGND	GND/ISOGND

To ensure that the "Receive Data" lines are in a proper state during inactive transmission periods, you must maintain certain bias voltage levels at the master and most distant slave units (end nodes). These end nodes also require the insertion of 100Ω terminating resistors to properly balance the network.

You must also configure switches at each node to establish proper network performance. Accomplish this by configuring switches listed so that the 100Ω termination resistors and biasing networks are installed at the end nodes and are removed at all other nodes on the network. You

enable receiver biasing and termination (as well as 2-wire or 4-wire selection) using an 8-position DIP switch located on the CPU and ECOM modules. See *Table 2-5* in *Section 2.4.2 Setting DIP Switches on the CPU Module*s for information on RS-485 termination and loopback control switch settings.

2.4.5 Connections to Ethernet Port(s) on the CPU Module

Caution

The RJ45 Ethernet ports are located on the CPU module. The PSSM also has one RJ45 port for the optional Display/Keypad. Never connect Ethernet to the Display/Keypad port or damage to the PSSM will result.

ControlWave Micros can support up to two Ethernet ports. These use a 10/100Base-T RJ-45 modular connector that provides a shielded twisted pair interface to an Ethernet hub. Two LEDs per port provide transmit and receive status indications:

Port assignments are:

- Ethernet Port 1: CPU Bd. J6, 8-Pin RJ-45 - Shielded Twisted Pair 10/100Base-T
- Ethernet Port 2: CPU Bd. J5, 8-Pin RJ-45 - Shielded Twisted Pair 10/100Base-T

A typical Ethernet hub provides eight 10/100Base-T RJ-45 ports (with port 8 having the capability to link either to another hub or to an Ethernet communications port). Both ends of the Ethernet twisted pair cable are equipped with modular RJ-45 connectors.

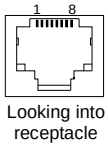

Figure 2-20. RJ-45 Ethernet Connector

These cables have a one-to-one wiring configuration as shown in *Figure 2-21*. *Table 2-14* provides the assignment and definitions of the 8-pin 10/100Base-T connectors.

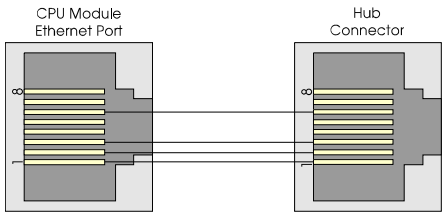

Figure 2-21. Standard 10/100Base-T Ethernet Cable (CPU Module to Hub)

Table 2-14. Ethernet 10/100Base-T CPU Module Pin Assignments

Pin	Description
1	Transmit Data+ (Output)
2	Transmit Data– (Output)
3	Receive Data+ (Input)
4	Not connected
5	Not connected
6	Receive Data– (Input)
7	Not connected
8	Not connected

Note: You can swap TX and RX at the hub.

You can connect two nodes in a point-to-point configuration without using a hub. However, you must configure the cable so that the TX+/- Data pins connect to the RX+/- Data pins (swapped) at the opposite ends of the cable (see *Figure 2-22*).

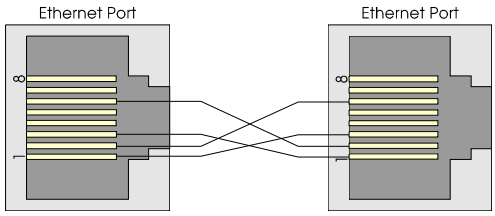

Figure 2-22. Point-to-Point 10/100Base T Ethernet Cable

The maximum length of one segment (CPU to hub) is 100 meters (328 feet). The use of Category 5 shielded cable is recommended.

2.5 Expanded Communications Module (ECOM)

ControlWave Micros can support up to two optional expanded communications modules (ECOMs) which you can install **only** in slots #3 or #4 (in place of I/O modules). ECOMSs **do not** have a CPU component.

Two Types of ECOM Modules

There are two types of ECOM module:

- Type 1 Expansion Communications Module (ECOM1) with one RS-232 port, one RS-485 serial port, and an optional modem port (see *Figure 2-23*)
- Type 2 Expansion Communications Module (ECOM2) with two RS-232 serial ports and two RS-485 serial ports (see *Figure 2-24*)

Identify the carton holding the ECOM module(s) and remove the module from that carton.

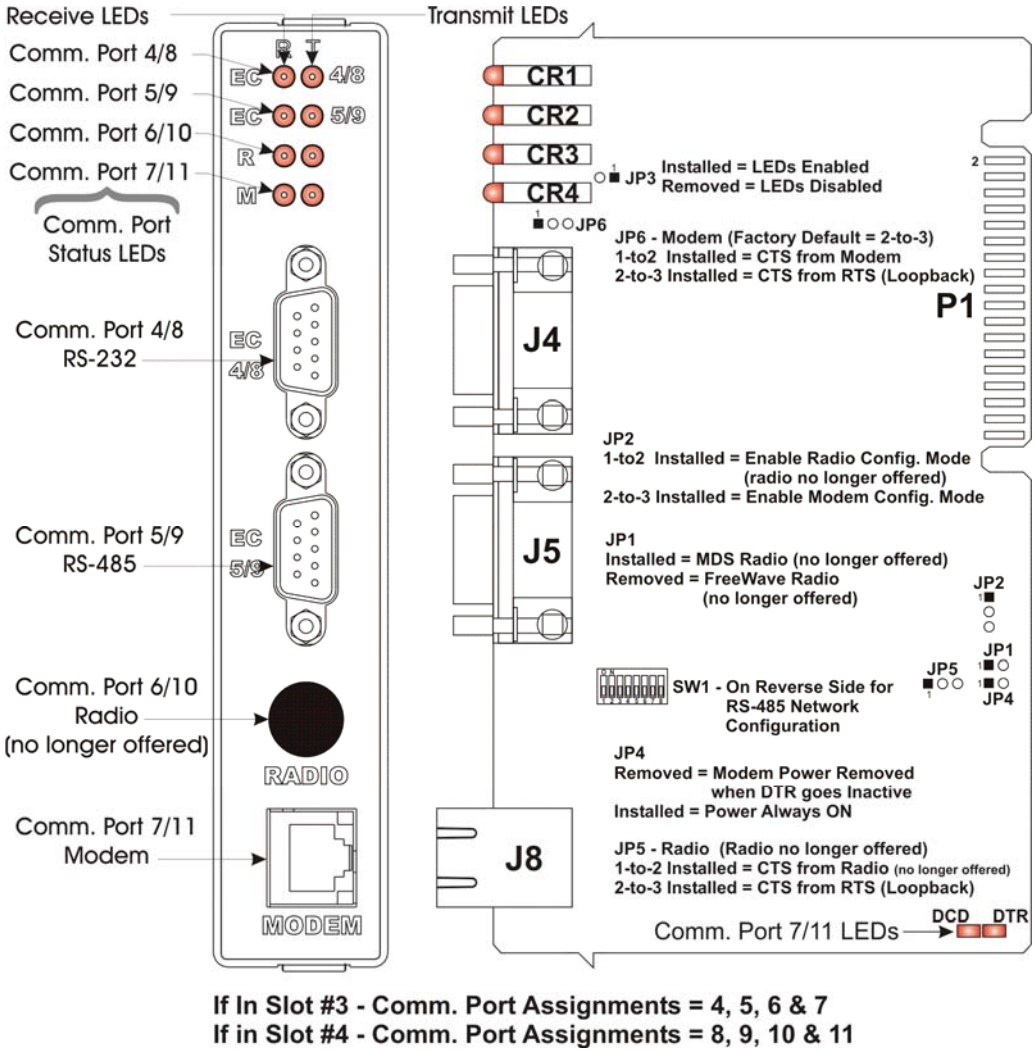
Receive LEDs
Transmit LEDs
Comm. Port 4/8
Comm. Port 5/9
Comm. Port 6/10
Comm. Port 7/11
Comm. Port Status LEDs
Comm. Port 4/8 RS-232
Comm. Port 5/9 RS-485
Comm. Port 6/10 Radio (no longer offered)
Comm. Port 7/11 Modem
RADIO
MODEM
CR1
CR2
CR3
CR4
JP3 Installed = LEDs Enabled Removed = LEDs Disabled
JP6
JP6 - Modem (Factory Default = 2-to-3)
1-to2 Installed = CTS from Modem
2-to-3 Installed = CTS from RTS (Loopback)
P1
J4
J5
J8
JP2
1-to2 Installed = Enable Radio Config. Mode (radio no longer offered)
2-to-3 Installed = Enable Modem Config. Mode
JP1
Installed = MDS Radio (no longer offered)
Removed = FreeWave Radio (no longer offered)
SW1 - On Reverse Side for RS-485 Network Configuration
JP5
JP4
JP4
Removed = Modem Power Removed when DTR goes Inactive
Installed = Power Always ON
JP5 - Radio (Radio no longer offered)
1-to-2 Installed = CTS from Radio (no longer offered)
2-to-3 Installed = CTS from RTS (Loopback)
Comm. Port 7/11 LEDs
DCD
DTR
If In Slot #3 - Comm. Port Assignments = 4, 5, 6 & 7
If in Slot #4 - Comm. Port Assignments = 8, 9, 10 & 11

Figure 2-23. Type 1 ECOM with Two Serial Ports and a Modem

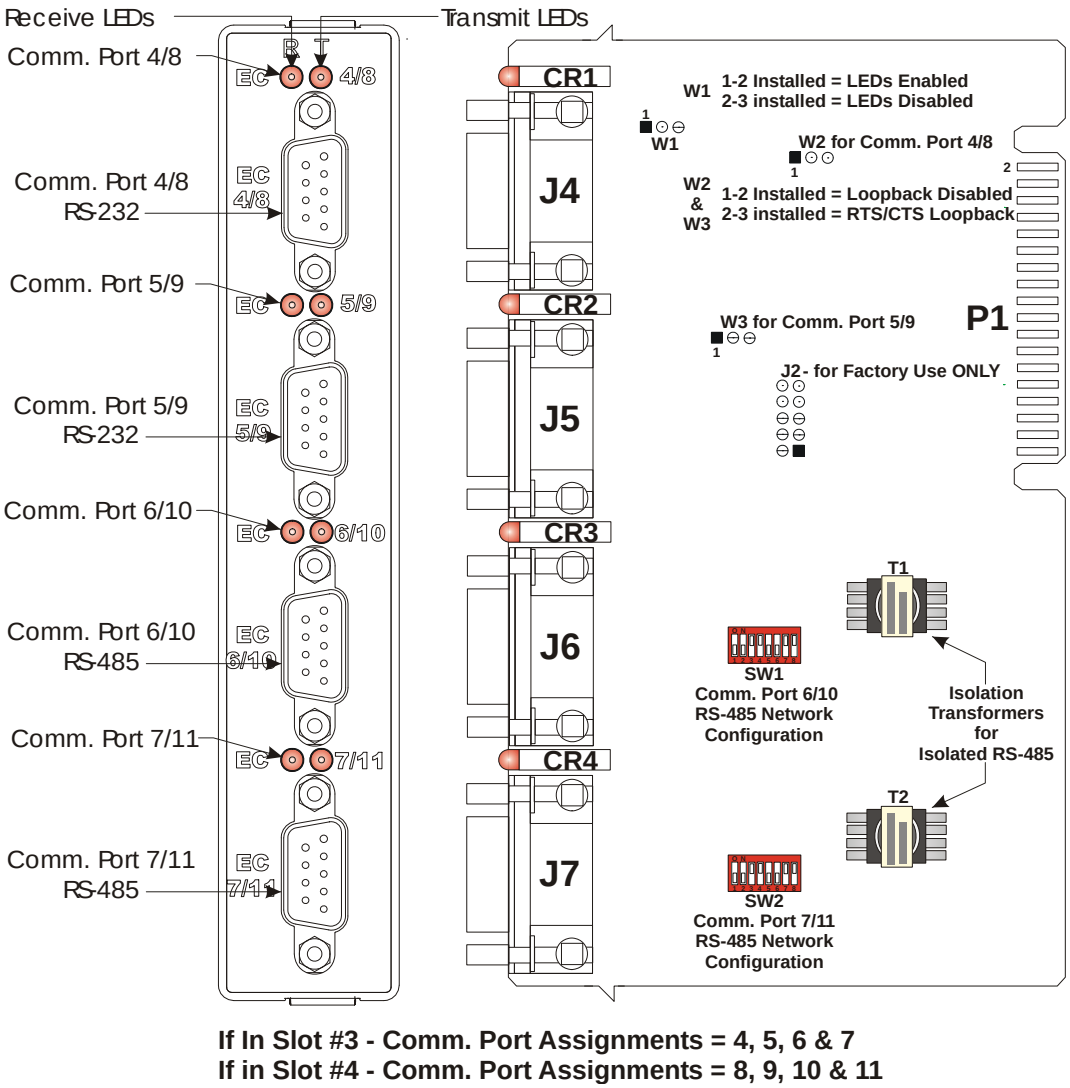

Figure 2-24. Type 2 ECOM with Two RS-232 and Two RS-485 Ports

Detailed Technical Specifications For detailed technical specifications, please see document CWMICRO:COM available on our website http://www.emersonprocess.com/remote/D301673X012.pdf.

2.5.1 RS-232 Ports

Type 1 ECOMs include one RS-232 port. Type 2 ECOMs include two RS-232 ports. For information on connecting to these ports, including cabling information, see *Section 2.4.3.*

2.5.2 RS-485 Ports

Type 1 ECOMs include one RS-485 port. Type 2 ECOMs include two RS-485 ports. For information on connecting to these ports, including cabling information, see *Section 2.4.4.*

When connecting a ControlWave Micro to an external modem, use the cable configuration in *Figure 2-25*.

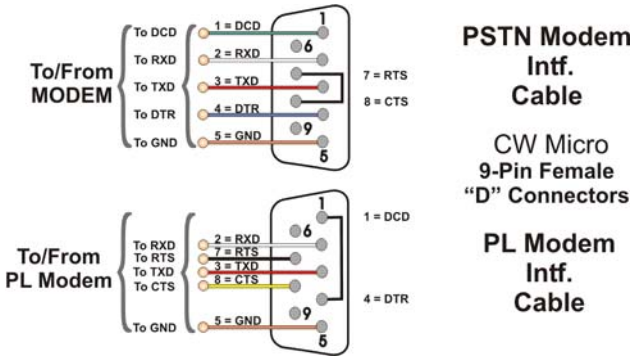

Figure 2-25. Full-duplex and Half-duplex Cable

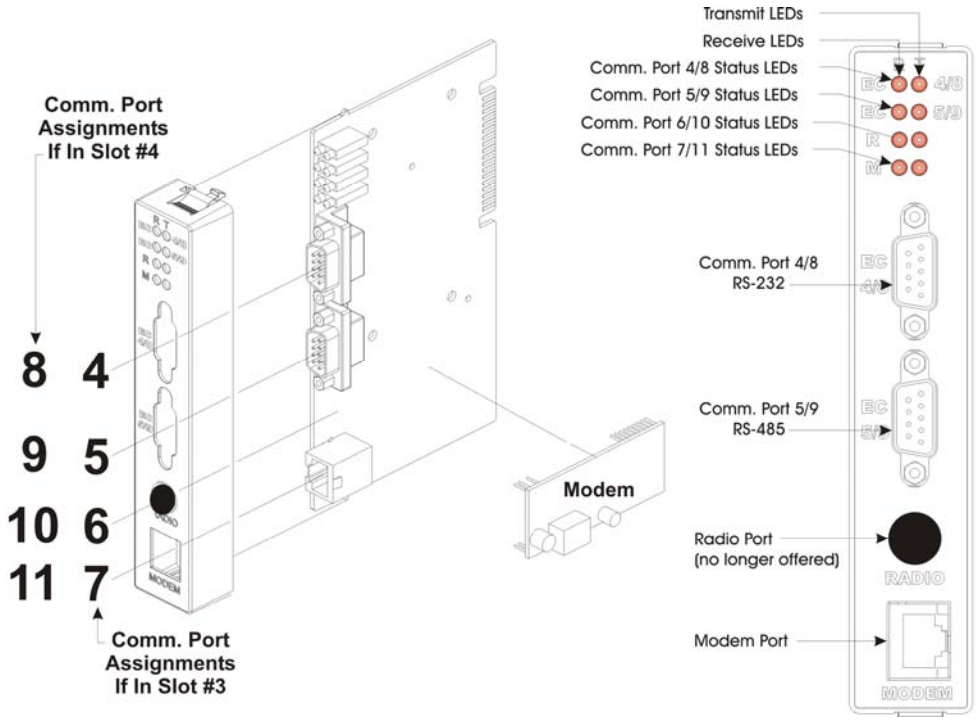

Figure 2-26. ECOM Modem Installation

2.5.3 Modem Port (Type 1 ECOM only)

You can mount an optional 56Kb PSTN Hayes-type modem on a Type 1 ECOM (see *Figure 2-26*).

The ControlWave Micro then assigns the modem COM7 (if in slot #3) or COM11 (if in slot #4).

You can configure the MultiTech model MT9234SMI modem module for publicly switched telephone network (PSTN) operation. You can

also clock DTE/DCE serial data into (transmit) or out of (receive) the modem at rates up to 115.2 kHz.

The factory supplies the modem pre-installed or in kit form with all required hardware. You install it on the ECOM1 module and then use the Ports page in the Flash Configuration utility (in NetView, LocalView, or TechView) to assign ports. Configure a profile for the modem using AT commands submitted using a terminal emulation program (such as HyperTerminal). Users typically use AT commands only when checking the modem's active or stored profile or when reconfiguring a modem (to turn auto answer on or off, etc.).

Prior to shipment from the factory, the MultiTech modems are pre-configured using the following steps:

1. Connect pin Enable modem setup by setting jumper JP2 on the ECOM to 2-3.
2. Connect via HyperTerminal (Parameters = 9600, 8, N, 1, None) to ECOM port C1 using the null modem cable (see *Figure 2-17*).
3. Send Factory Default = **AT&F0**
4. Disable Flow Control = **AT&K0**
5. Set baud rate using AT Command: **AT$SB9600,** or whatever baud rate you require.
6. Write to Memory. = **AT&W**
7. Disable setup mode. Park JP2 (no connection)

Note: You can reconfigure the modem using AT commands and a terminal program (like HyperTerminal). Connect pins 2 and 3 of JP2 with a suitcase jumper, and use a null modem cable (see *Figure 2-17*) to connect the PC to the modem (COM4 or COM8).

PSTN Connections

Figure 2-27 shows a publicly switched telephone network (PSTN) using a single master and three remote ControlWave Micros (each equipped with a PSTN modem). This application requires only one remote connection.

Use a cable with standard telephone connectors (RJ11s) on each end. Plug one end of the cable into the RJ11 connector jack on the ECOM and the end into a RJ11 wall jack. The telephone company provides the necessary subscriber loops at its central system along with the phone numbers for each destination.

Caution **Connect only one modem on each drop. If you attempt to parallel two or more modems across a single drop, an impedance mismatch occurs, adversely affecting the signal. Modems cannot provide reliable communications under these conditions.**

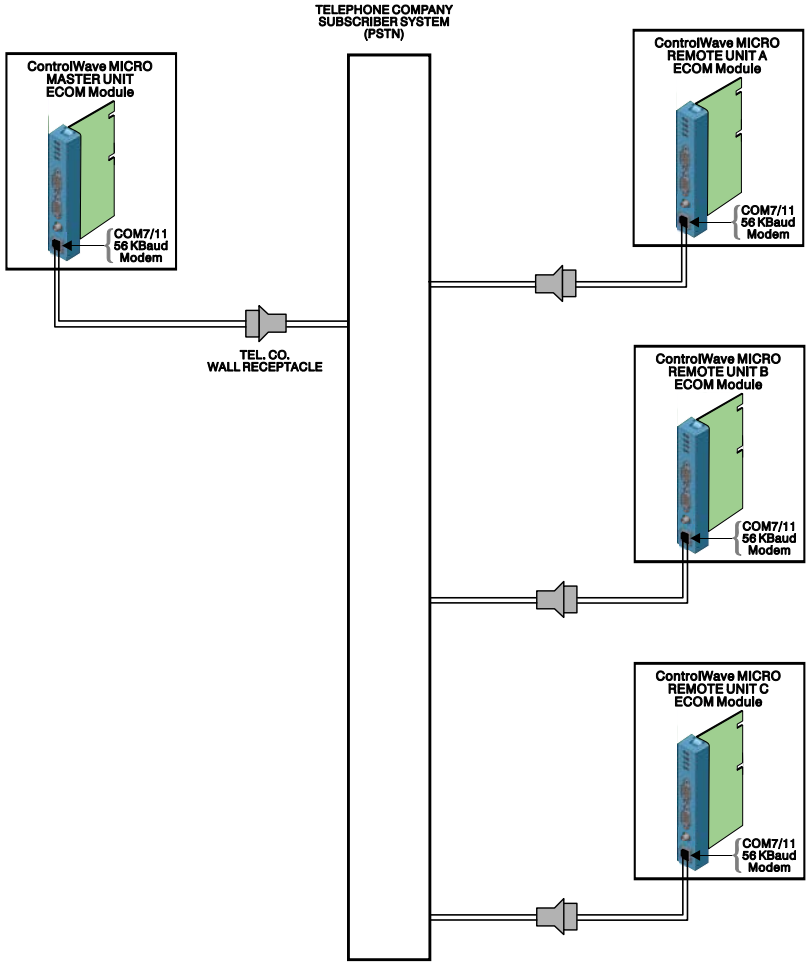

Figure 2-27. PTSN Field Connections for ControlWave Micros

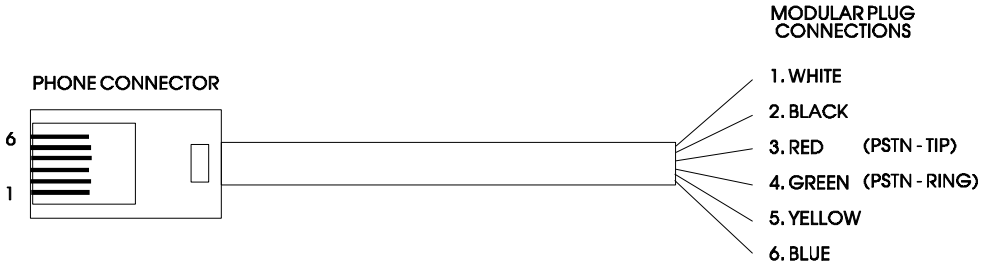

Figure 2-28. Phone Cord Wiring

The 56K PSTN modem is FCC-approved for use with public telephone lines. However, before you place a modem in operation, check the following items to make sure you meet all FCC requirements:

- Connections to party line service are subject to state tariffs.
- Connections to telephone company-provided coin service (central office implemented systems) are prohibited.
- The equipment compliance information is summarized as follows:
  - Complies with Part 68 FCC Rules.

- Contains device with FCC Registration Number: AU7-USA-25814-M5-E
- Ringer Equivalence Number (REN): 0.3B

Note: The sum of all the RENs on your telephone lines should be less than five in order to assure proper service from the telephone company. In some cases, a sum of five may not be usable on a given line.

- Make any direct connections to PSTN lines through standard plugs and jacks as specified in the FCC rules. The PSTN line connector plugs into J1 on the modem. Notify your telephone company that the jack (connector) required for your device is one of the following:
  - USOC: RJ11C **or**
  - USOC: RJ11W

Note: The jack provided on the Modem (J1) is a 6-pin TLECO RJ-11. The connections to the modem are pin 3 PSTN-Tip, and pin 4 PSTN-Ring.

- After the telephone company has installed the above jack, connect the modem to your equipment by inserting the appropriate equipment interface RJ11 plug into the modem and wall connector.

2.6 Bezels

Bezels are blue plastic covers (see *Figure 2-29*) that protect an adjacent pair of I/O modules and provide an easy way for you to route wiring. The factory provides bezels with each order. Install bezels over I/O modules whenever the ControlWave Micro is operational; remove the bezels for maintenance procedures.

Bezels attach to the module covers of two adjacent I/O modules. Hooks on the bezels (see *Figure 2-29*) attach to notches in the upper and lower portions of the module covers. Align the hooks on the bezel with the notches on the I/O module covers and slide the bezel down. To remove the bezel, grasp its sides and gently squeeze them, and pull up and then away from the I/O modules.

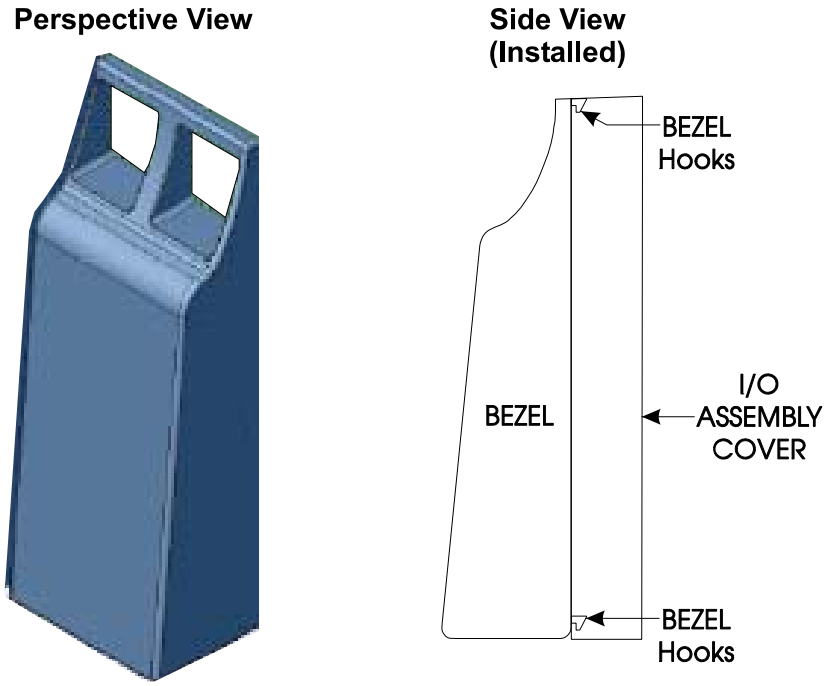

Figure 2-29. Bezel Assembly

2.7 Optional Display/Keypads

The ControlWave Micro supports two optional display/keypads:

- A 2-button keypad (shown in the left of *Figure 2-30*)
- A 25-button keypad (shown in the right *Figure 2-30*)

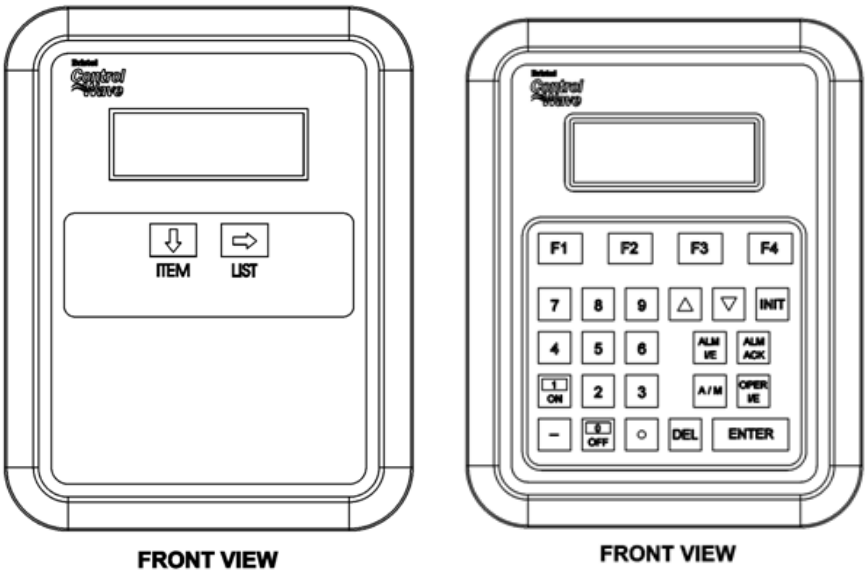

Figure 2-30. Optional 2-Button and 25-Button Keypads

Both keypads use the same 4-line by 20-character LCD displays. You connect the keypad to the ControlWave Micro using a cable, one end of which has an RJ-45 jack (connected into the RJ-45 equipped with two plugs. This cable connects between the RJ-45 display jack (J1) on the PSSM Board and RJ-45 jack (J1) on the remote Display/Keypad assembly. A potentiometer, provided on the keypad, allows you to set the contrast of the LCD display.

Note: For further information on the installation and use of the optional keypads, refer to the *ControlWave Display/Keypad Manual (D5135)*.

Chapter 3 – I/O Modules

This chapter discusses the placement and wiring for I/O modules for the ControlWave Micro. The chapter begins with some general instructions on module installation that are common to most I/O modules. The balance of the chapter includes specific details for configuring and wiring each type of I/O module.

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3.2 Wiring 3-2
3.3 Isolated Digital Input (DI) Module 3-5
3.4 Isolated Digital Output (DO) Module 3-10
3.5 Non-isolated Digital Input/Output (DI/O) Module 3-14
3.6 Non-isolated Analog Input/Output & Analog Input Module 3-17
3.7 Non-isolated High Speed Counter (HSC) Input Module 3-21
3.8 Isolated Analog Input (AI) Module 3-25
3.9 Isolated Analog Output (AO) Module 3-29
3.10 Non-isolated Mixed I/O (MI/O) Module 3-32
3.11 Isolated Vac Digital Input Module 3-38
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Installation

Installing any I/O module in the ControlWave Micro involves the same basic steps:

1. Remove the I/O module and associated I/O module cover from the shipping carton.

   Note: Modules normally ship from the factory completely assembled.

2. Align the I/O module with its intended slot on the base or expansion housing and slide the module into the housing. Make sure the module snaps into the appropriate securing notches on the housing.
3. Wire and plug the local or remote cable assemblies into the appropriate module connectors.
4. After installing and wiring two I/O modules into adjacent slots in the housing, cover the modules with a protective bezel. The bezels snap on and off for maintenance.
5. Using a PC running the ControlWave Designer and OpenBSI software, configure the ControlWave Micro to accept the new I/O modules and download the revised ControlWave project.

Note: This step is beyond the scope of this manual. Refer to the *ControlWave Designer Programmer's Handbook* (D5125) for further instructions.

⚠ Caution

Power down the ControlWave Micro before you install or remove any I/O module. Shut down any processes the ControlWave Micro may be managing (or switch them over manually or handle with another controller). Perform any hardware configuration (wiring, jumper configuration, and installation) only when the ControlWave Micro is powered down.

Before any I/O modules can become operational, you must use ControlWave Designer to configure and then download the application (project).

Do not install any modules in the base or expansion housings until you have mounted and grounded those housings at the designated installation site.

To ensure safe use of this product, please review and follow the instructions in the following supplemental documentation:

- **Supplement Guide - ControlWave Site Considerations for Equipment Installation, Grounding, and Wiring (S1400CW)**
- **ESDS Manual – Care and Handling of PC Boards and ESD Sensitive Components (S14006)**

3.1 Module Placement

You can place I/O modules in the base or expansion housing:

- 3-slot base housing: supports one I/O module in slot 3.
- 4-slot base housing: supports up to two I/O modules in slots 3 and 4.
- 8-slot base housing: supports up to six I/O modules in slots 3 through 8.
- 2-slot expansion housing: supports up to two I/O modules.
- 4-slot expansion housing: supports up to four I/O modules.
- 8-slot expansion housing: supports up to eight I/O modules.

Note: Some modules have placement restrictions. Note these in the individual descriptions.

3.2 Wiring

With a few exceptions (noted in the module descriptions), I/O modules support either "local termination" (field wiring connected directly to the module's removable terminal blocks) or "remote termination" (field wiring connected to the remote headers under the module's cover and routed to a DIN-rail mounted terminal assembly and then to field devices).

ControlWave Micro I/O modules use compression-type terminals that accommodate up to #14 AWG wire. Insert the wire's bared end (approx. ¼" max) into the clamp beneath the screw and secure the wire. To prevent shorts, ensure that no bare wire is exposed. If using standard wire, tin the bare end with solder to prevent flattening and improve conductivity. Allow some slack in the wires when making terminal connections. Slack makes the wires more manageable and helps minimize mechanical strain on the terminal blocks.

3.2.1 Local Termination

For I/O modules equipped with local terminal blocks, install the field wiring between the I/O module's removable terminal block connectors and field devices (see *Figure 3-1*). Use AWG 14 or smaller wire (consult with the field device manufacturer for recommendations). Leave some slack and plan for wire routing, identification, and maintenance. Route the bundled wires out through the bottom of the I/O module assembly between the terminal block and the terminal housing.

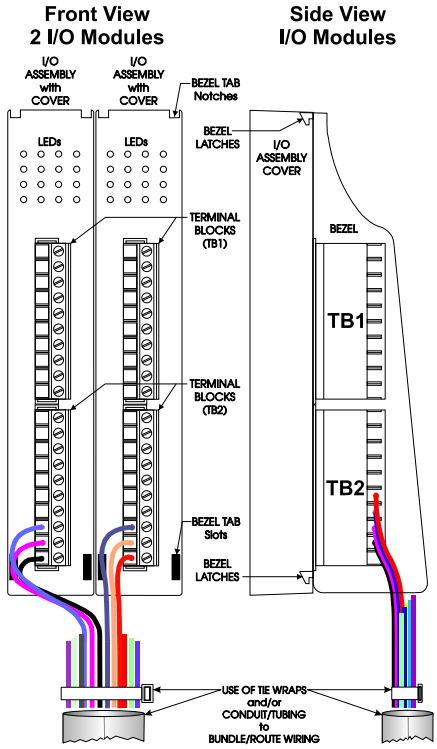


Figure 3-1. Module Wiring: Local Termination

3.2.2 Remote Termination

For I/O modules that support remote terminations, install cables between the module's remote headers and the remote DIN-rail mounted terminal block assemblies (see *Figure 3-2*). Install field wiring between the DIN-rail mounted terminal bock assembly and field devices (see the wiring diagrams associated with each I/O module description).

Use AWG 14 or smaller wire (consult with the field device manufacturer for recommendations) for remote terminations. Leave some slack and plan for wire routing, identification, and maintenance. Route the cables running between the I/O module and the DIN-rail mounted terminal blocks out through the bottom of the I/O module assembly via the bezel assembly.

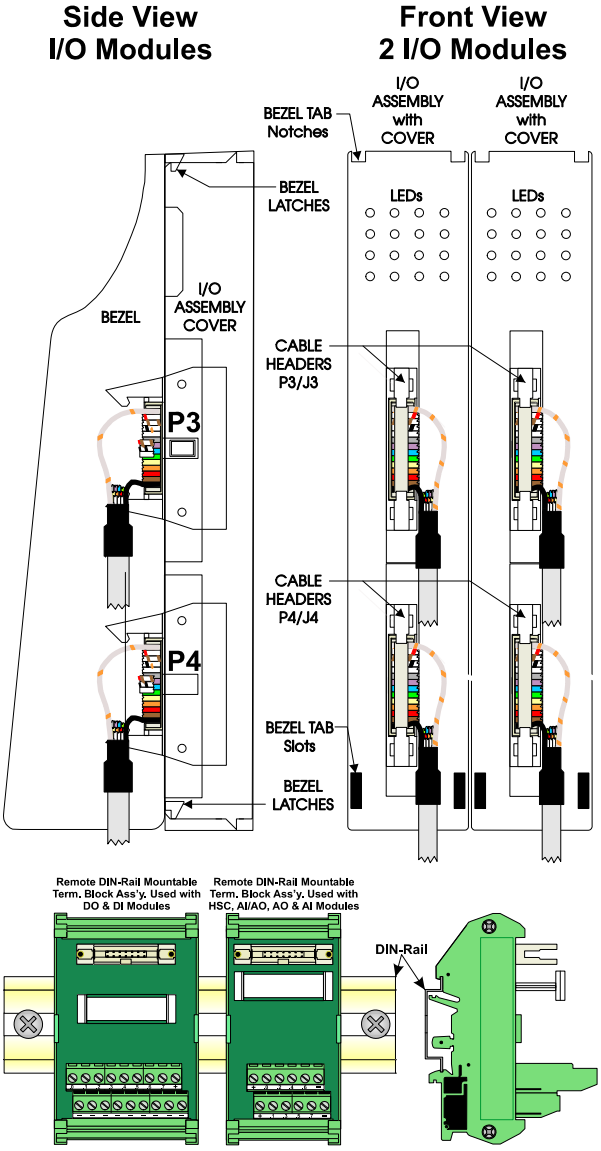


Figure 3-2. Module Wiring: Remote Termination

3.2.3 Shielding and Grounding

Use twisted-pair, shielded and insulated cable for I/O signal wiring to minimize signal errors caused by electromagnetic interference (EMI), radio frequency interference (RFI), and transients. When using shielded cable, ground all shields at only one point in the appropriate system. This prevents circulating ground current loops that can cause signal errors.

3.3 Isolated Digital Input (DI) Module

Isolated DI modules provide 16 isolated digital inputs. For 24V DI modules you can individually configure inputs for either externally sourced inputs or internally powered (dry contact) applications.

Table 3-1. Isolated DI Module General Characteristics

Type	Number Supported	Characteristics
Digital Inputs (DI)	16	Each DI supports/ includes: ▪ Nominal input voltage of 12V or 24Vdc ▪ Nominal input current of 5 mA ▪ 30 ms input filtering ▪ Dedicated LED on module turns ON when DI is ON. (not available on all module versions)

A DI module consists of an isolated digital input printed circuit board (PCB) with either two 10-point terminal block assemblies (for local termination) or two 14-pin mass termination headers (for remote termination). Each DI module also includes 19 configuration jumpers and a module cover. The DI PCB connects to the backplane using a 36-pin gold-plated card-edge connector.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

Isolated Digital Input (DI) modules (general part number **396571-XX-X**) come in different configurations. See *Table 3-2* to see the variations.

Table 3-2. Isolated DI Module Configurations

Part Number	Termination Connector	Notes
396571-02-6	24V local	Includes LED daughterboard.
396571-04-2:	24V remote	Includes LED daughterboard.
396571-07-7	12V local	**Does NOT support internal power source.** Includes LED daughterboard.

Figure 3-3, Figure 3-4, and *Figure 3-5* show wiring for the DI module.

Isolation

Surge suppressors and optocouplers electrically isolate the DI field circuitry from the module's bus interface circuitry. 24V input modules configured for use in dry contact applications contain a +21 Vdc isolated power supply powered by the output of the +VIN power

source originating on the Power Supply/Sequencer module (PSSM).

Setting Jumpers

Set configuration jumpers W1 through W19 according to *Table 3-3*. Use jumper W19 (see *Figure 3-3*) to enable or disable the +21 Vdc field power supply.

Note: Jumpers W1 through W12 and W15 through W19 only apply to 24V DI Modules.

Table 3-3. Jumper Assignments: Isolated DI Module

Jumper	Purpose	Description
WI	Configures DI1	Pins 2-3 & 4-5 installed = External Power DI Pins 1-2 & 3-4 installed = Internal Source DI
W2-W12	Configures DI2 through DI12 (respectively)	Same as W1
W13	Enables LEDs	Pins 1-2 installed = allows hardware to enable LEDs Pins 2-3 installed = allows software to enable LEDs
W14	Programs Serial EEPROM	**Reserved for factory use only**
W15	Configures DI13	Same as W1
W16	Configures DI14	Same as W1
W17	Configures DI15	Same as W1
W18	Configures DI16	Same as W1
W19[1]	Enables VIN	Pins 1-2 enable VIN Pins 2-3 disable VIN

1 You must install a jumper on pins 1-2 of W19 to configure **any** DI for internally sourced operation.

Wiring the Module

Figure 3-3 shows field wiring assignments associated with locally terminated DI modules; *Figure 3-4* shows field wiring assignments associated with remotely terminated DI modules. *Figure 3-5* shows an optional remote termination module with built-in discrete relay module that supports input from 120 Vac DIs. The special remote termination module (with built-in discrete relay module) interfaces with an externally sourced DI module.

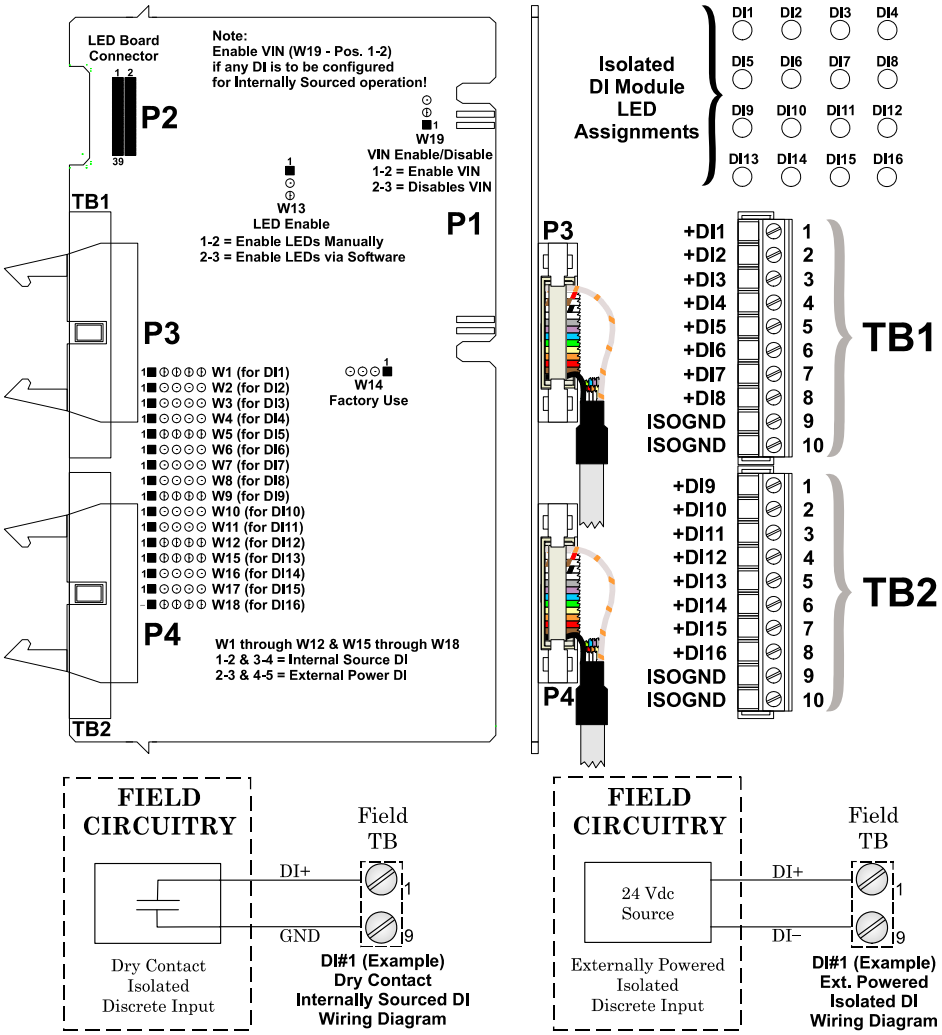


Figure 3-3. Isolated DI Module (Local Termination)

Figure 3-4 shows the wiring assignments associated with a DIN-rail mounted terminal block assembly for a DI module associated with either internally sourced or externally powered operation. *Figure 3-5* shows the wiring assignments associated with a DIN-rail mounted terminal block assembly for a DI module associated with relay isolated 120 Vac operation.

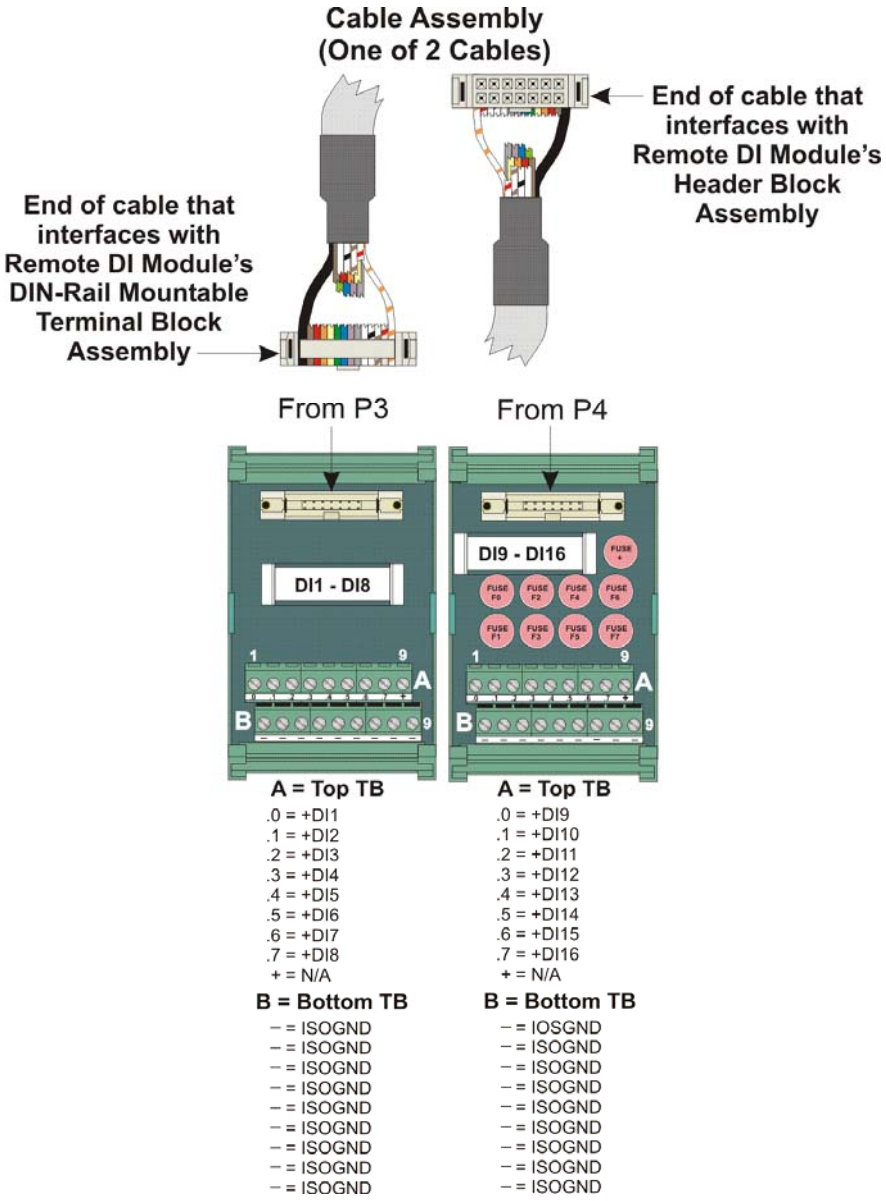


Figure 3-4. Isolated DI Module (Remote Termination, Internally Sourced or Externally Powered)

Note: Fuses F0 to F7 are 1/8 A; F+ is a 2A fuse.

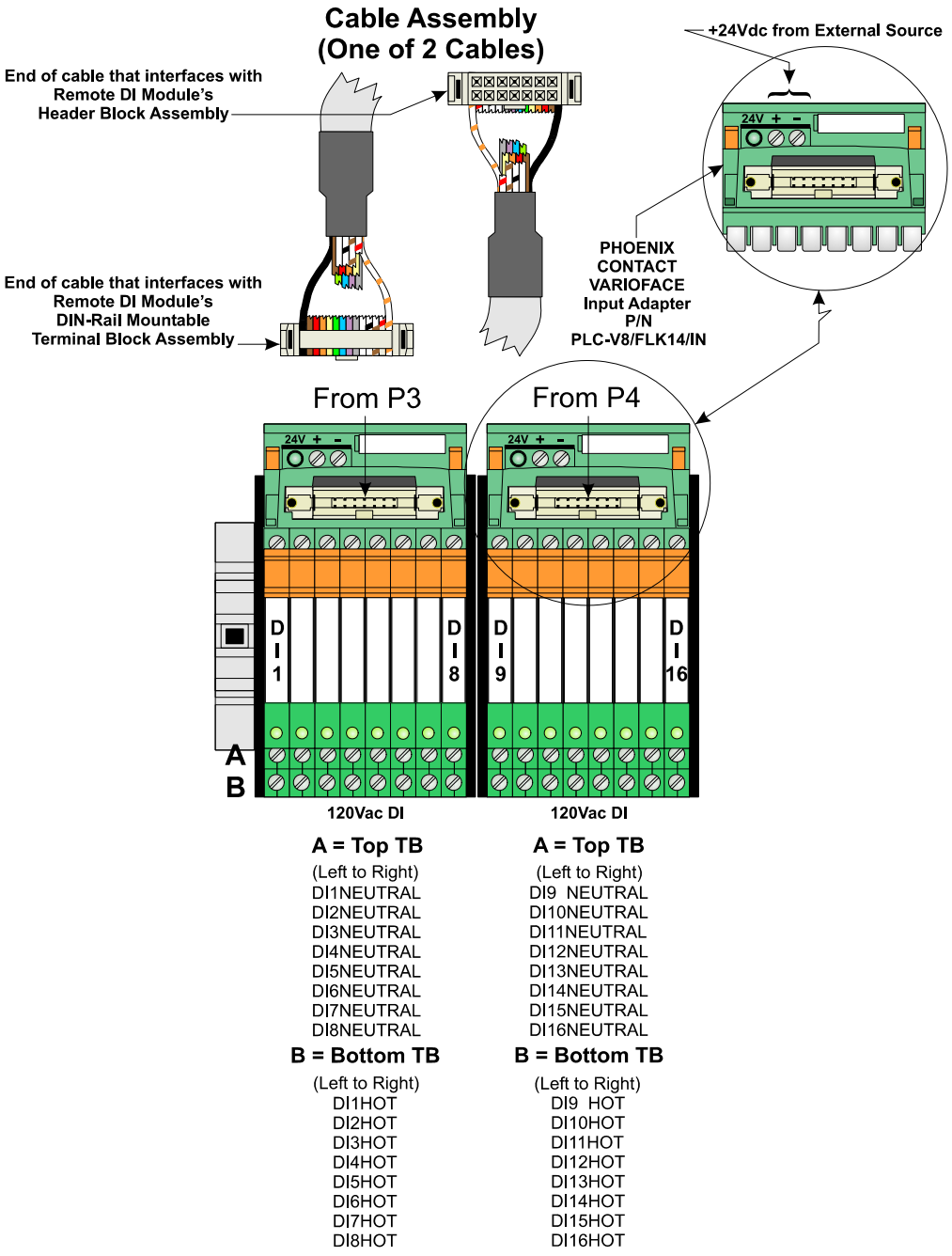


Figure 3-5. Isolated DI Module (Remote Termination, Internally Sourced or Externally Powered with and without Fuses)

Software Configuration

To use data from an isolated DI module you must add a **CWM_DI16** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.4 Isolated Digital Output (DO) Module

Isolated DO modules provide 16 DOs to control signaling functions.

DO modules consist of a DO PCB with either two 10-point terminal block assemblies (for local termination) or two 14-pin mass termination headers (for remote termination). DO modules also include two configuration jumpers, an LED board with 16 status LEDs (one for each point), and a cover assembly. The DO PCB connects with the backplane using a 36-pin gold-plated card-edge connector.

Table 3-4. Isolated DO Module General Characteristics

Type	Number Supported	Characteristics
Digital Outputs (DO)	16	Each DO supports/ includes: ▪ Optically isolated open source MOSFET with surge suppression that is capable of handling 500mA at 30V. ▪ Dedicated LED on module turns ON when DO is ON.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

The isolated Digital Output (DO) module (general part number **396572-XX-X**) comes in two possible configurations, see *Table 3-5*:

Table 3-5. Isolated DO Module Configurations

Part Number	Termination Connector	Notes
396572-02-2	local	Includes LED daughterboard.
396572-04-9	remote	Includes LED daughterboard.

Isolation

Surge suppressors and optocouplers electrically isolate the DO field circuitry MOSFETs from the module's bus interface circuitry.

DO modules provide a total of 16 DOs with surge protection. Each DO uses an open source MOSFET that is capable of driving up to 31Vdc at up to 500mA. A 500Vdc MOV to chassis and a 31Vdc MOV (across output) are provided to protect each DO. The maximum operating frequency is 20 Hz.

Outputs set OFF on Power-up

An on-board DO load register stores output data. At power-up the load register clears and sets all outputs to "off."

Setting Jumpers

DO modules contain two configuration jumpers (W1 and W2), which

function as follows:

Table 3-6. Jumper Assignments: Isolated DO Module

Jumper	Purpose	Description
WI	Configures DI1	Pins 1-2 installed = Manually enables status LEDs Pins 2-3 installed = Software enables status LEDs See *Figure 3-6* for the location of this jumper.
W2	Programs serial EEPROM	**Reserved for factory use only**

Wiring the Module

Figure 3-6 shows field wiring assignments associated with a locally terminated DO module; *Figure 3-7* shows field wiring assignments associated with remotely terminated DO modules. *Figure 3-8* shows a remote termination module with built-in discrete relay modules.

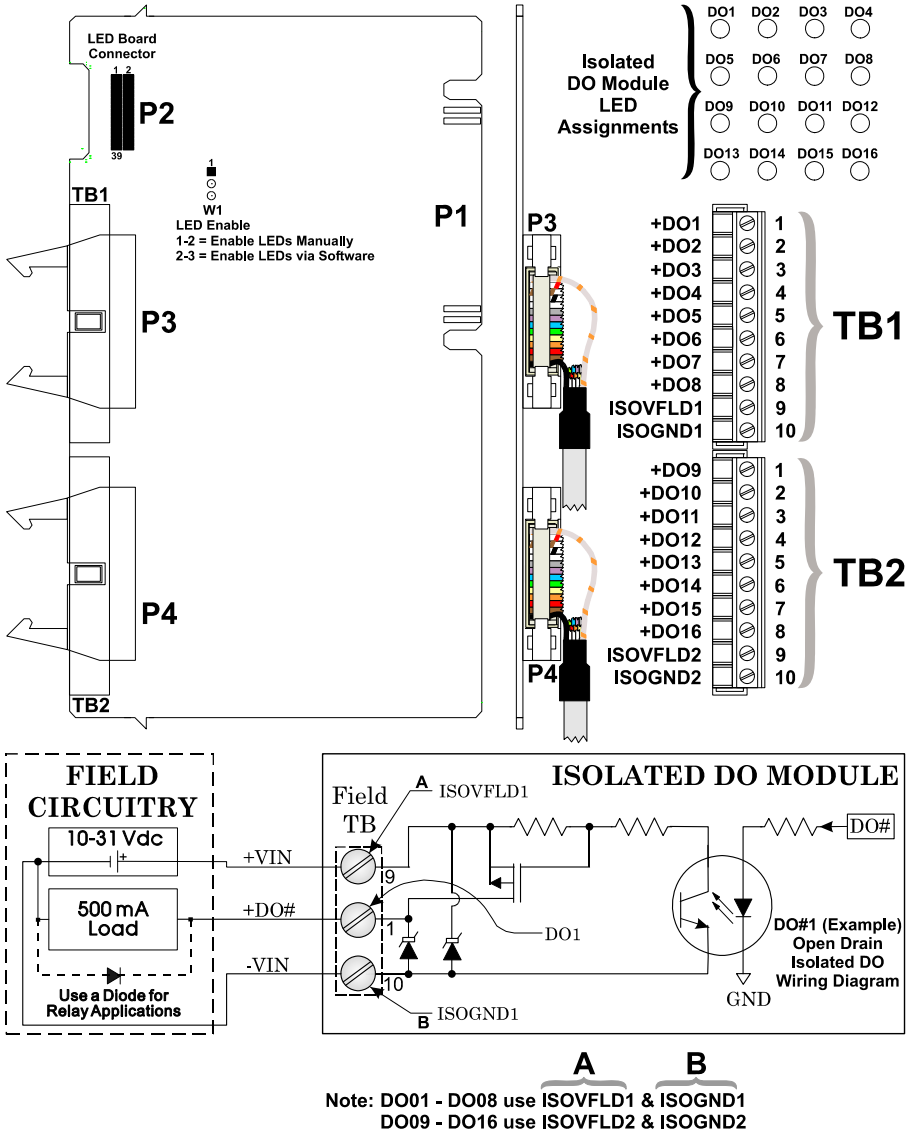


Figure 3-6. Isolated DO Module (Local Termination)

Figure 3-7 shows the terminal block assignments for a remotely terminated DIN-rail mounted open source isolated DO module. *Figure 3-8* shows the terminal block assignments for a remotely terminated DIN-rail mounted relay isolated 24 Vdc DO module.

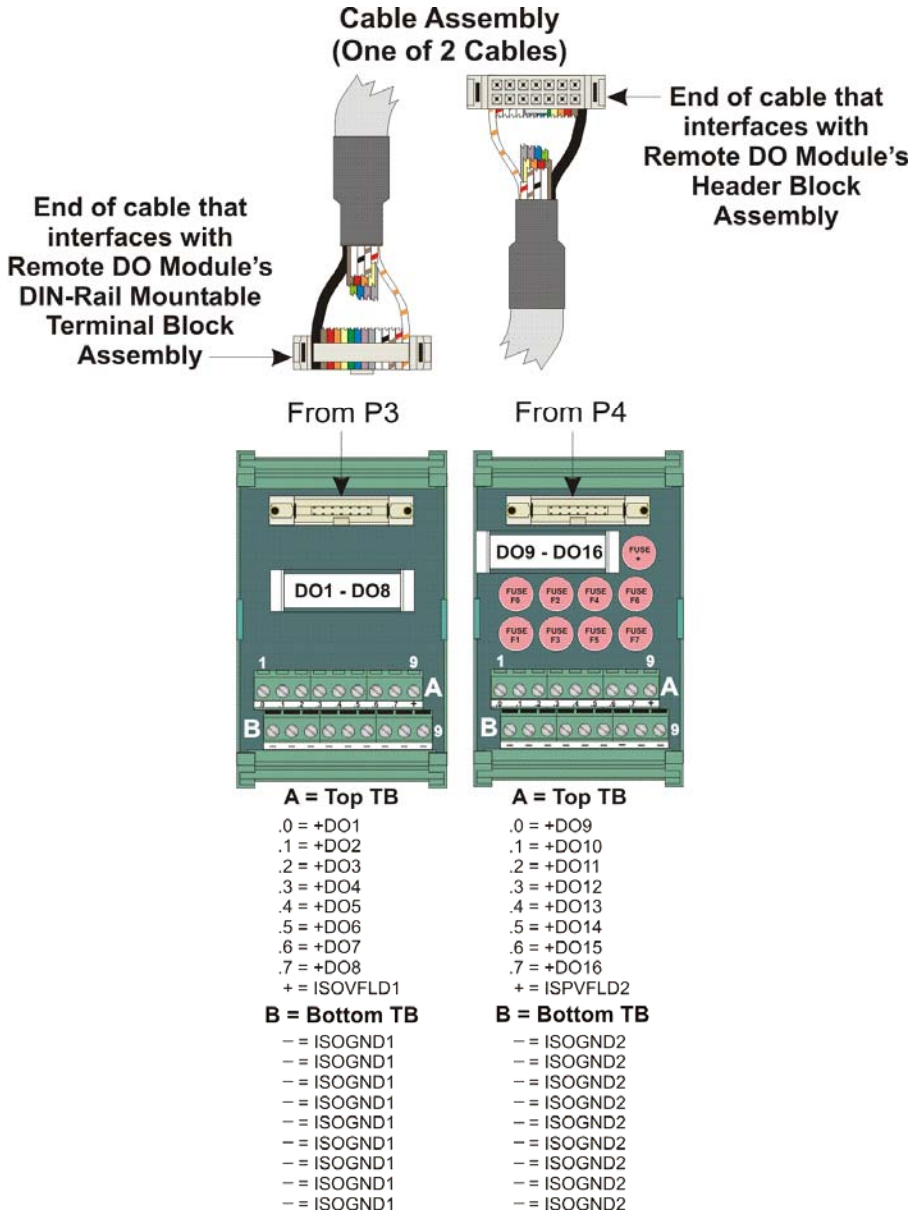


Figure 3-7. Isolated DO Module (Remote Termination)

Note: Fuses F0 to F7 are 1/8 A; F+ is a 2A fuse.

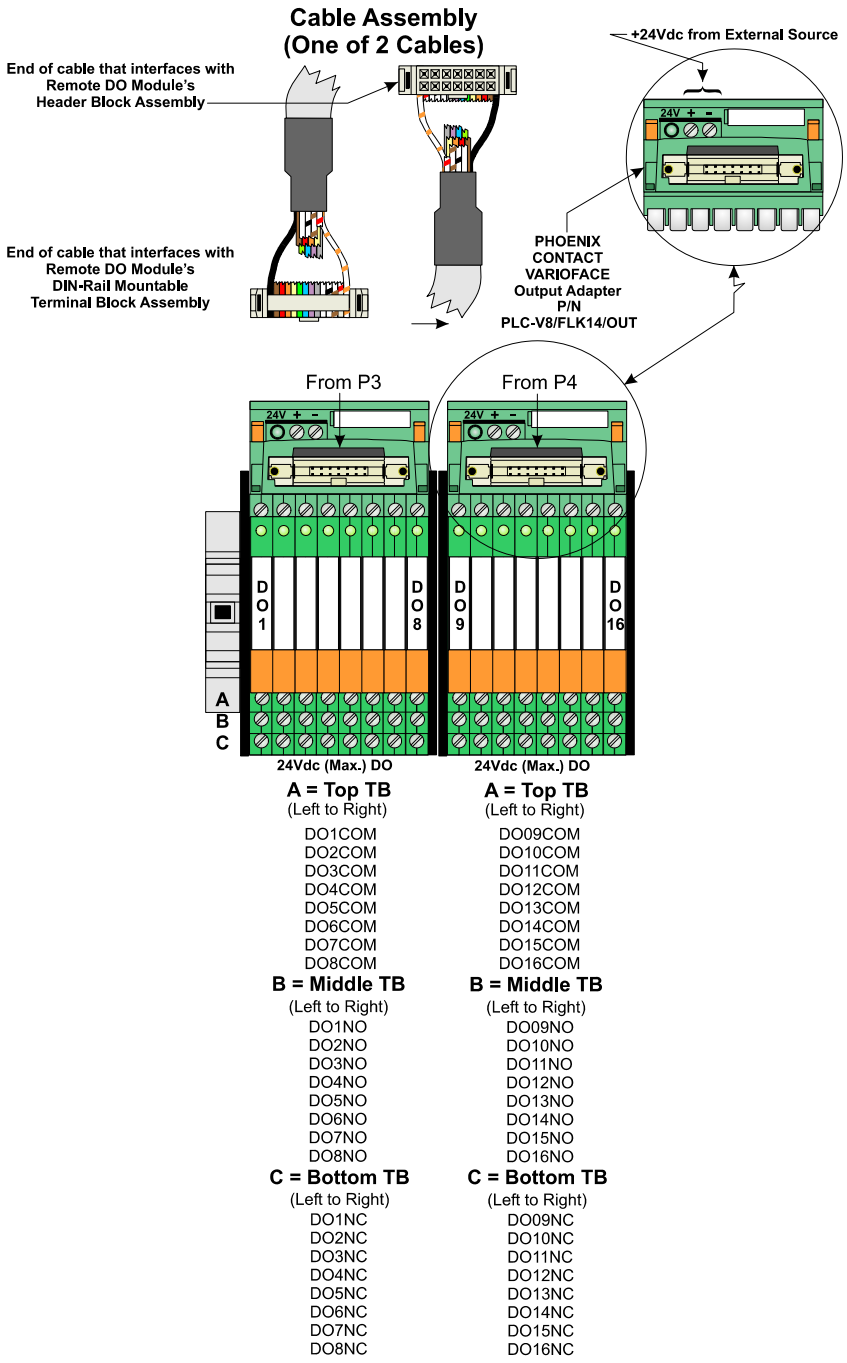


Figure 3-8. Isolated DO Module (Remote Termination with Relay Isolated with 24 Vdc)

Software Configuration

To use data from an isolated DO module you must add a **CWM_DO16** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.5 Non-isolated Digital Input/Output (DI/O) Module

Non-isolated DI/O modules consist of a digital input/output PCB with either two 10-point terminal block assemblies (for local termination) or two 14-pin mass termination headers (for remote termination). The DI/O module also includes 14 configuration jumpers, an LED board with 16 status LEDs (one for each point), and a cover assembly. The DI/O module connects with the backplane using a 36-pin gold-plated card-edge connector.

Non-isolated DI/O modules contain field interface circuitry for up to 12 digital inputs and four digital outputs.

Table 3-7. Non-Isolated DI/DO Module General Characteristics

Type	Number Supported	Characteristics
Digital Inputs (DI)	12	Each DI supports/ includes: ▪ Internally sourced DI operation for dry contacts pulled internally to 3.3Vdc when field input is open. ▪ Surge suppressor ▪ Signal conditioning ▪ Filter time of 15 ms ▪ Jumper to configure source current for either 2 mA or 60 uA ▪ Dedicated LED on module turns ON when DI is ON.
Digital Outputs (DO)	4	Each DO supports/ includes: ▪ Open drain MOSFET provides 100mA at 30Vdc to an externally powered device. ▪ Surge suppressor ▪ Current sink to ground of DI/DO module ▪ Dedicated LED on module turns ON when DO is ON.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

The non-isolated DI/O module (general part number **396567-XX-X**) comes in several different configurations. See *Table 3-8.*

Table 3-8. Non-Isolated DI/O Module Configurations

Part Number	Termination Connector	Notes
396567-02-9	local	Includes LED daughterboard.

Part Number	Termination Connector	Notes
396567-04-5:	remote	Includes LED daughterboard.

Setting Jumpers

DI/O modules provide 12 individually field configurable DIs and 4 non-configurable externally powered DOs.

Using configuration jumpers W1 through W12, you can set each DI individually to provide either a 2 mA or 60 uA source current. *Table 3-9* details jumper settings.

Table 3-9. Jumper Assignments: Non-isolated DI/O Module

Jumper	Purpose	Description
W1-W12	Configures DI1 through DI12 (respectively)	Pins 1-2 installed = 2mA Source Current Pins 2-3 installed = 60uA Source Current
W13	Enables LEDs	Pins 1-2 installed = allows manual enabling of LEDs Pins 2-3 installed = allows software enabling of LEDs
W14	Programs Serial EEPROM	**Reserved for factory use only**

Wiring the Module

Figure 3-9 shows the terminal block assignments for a locally terminated DI/O module. *Figure 3-10* shows the terminal block assignments for a DIN-rail mounted remotely terminated DI/O module.

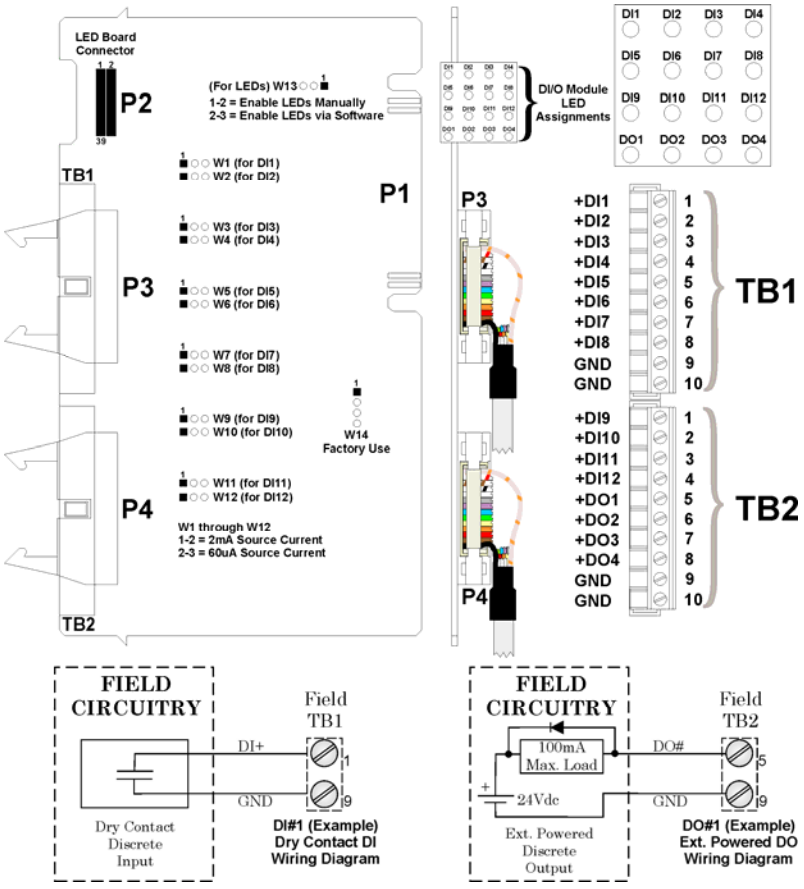


Figure 3-9. Non-isolated DI/O Module (Local Termination)

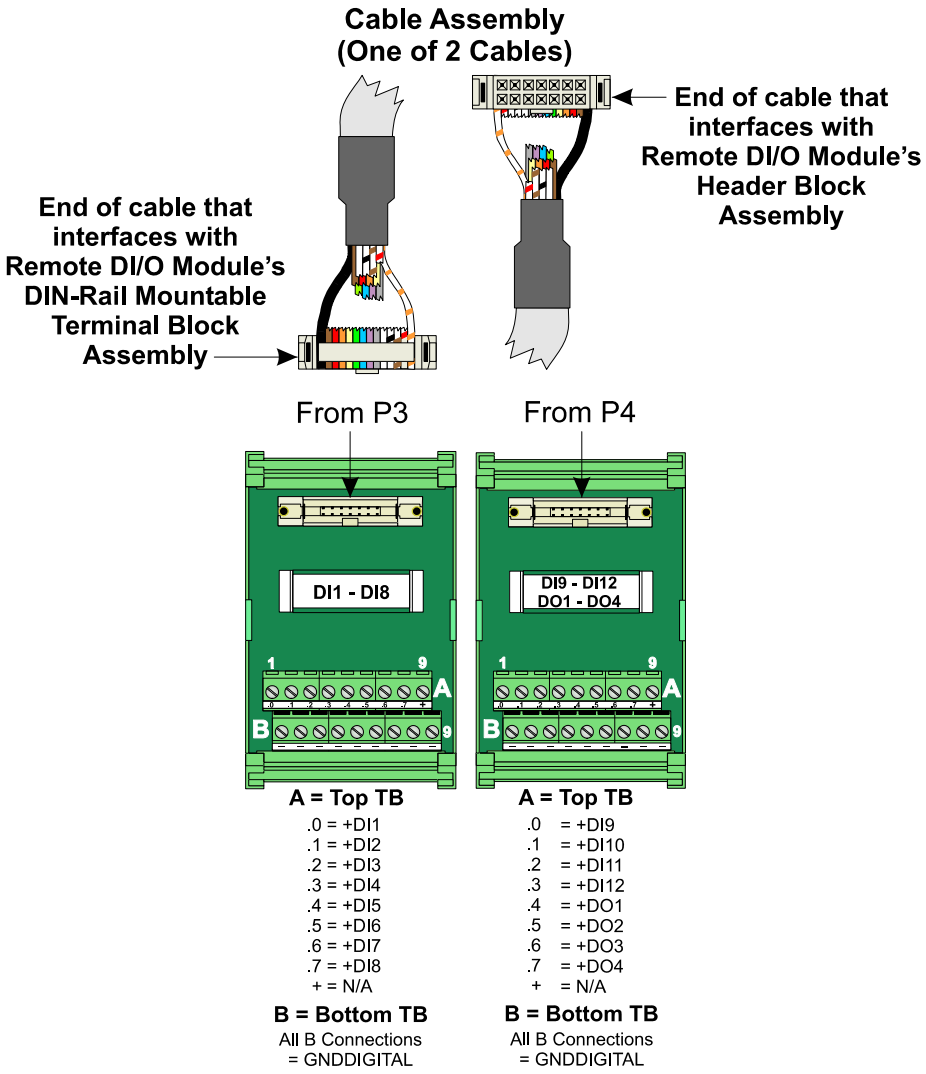


Figure 3-10. Non-isolated DI/O Module (Remote Termination)

Software Configuration

To use data from a non-isolated DI/O module you must add a **CWM_MD** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.6 Non-isolated Analog Input/Output & Analog Input Module

Non-isolated Analog Input/Output (AI/O) modules support six externally sourced 4–20mA or 1–5 Vdc single-ended analog inputs and optionally, two independently configurable 4–20 mA or 1–5 Vdc analog outputs. **Non-isolated Analog Input (AI) modules are identical to AI/O modules but have a depopulated AO section.**

AI/O modules consist of an AI/O PCB with two 10-point terminal block assemblies (for local termination) or two 14-pin mass termination headers (for remote termination), 12 configuration jumpers, and a cover assembly. The AI/O module connects with the backplane using a 36-pin gold-plated card-edge connector.

Table 3-10. Non-Isolated AI/O and AI Module General Characteristics

Type	Number Supported	Characteristics
Analog Inputs (AI)	6 on AI/O Module 6 on AI Module	Each AI supports/includes: ▪ Jumper to configure input for either 4–20mA or 1–5 Vdc ▪ Signal conditioning that provides 2 Hz low pass filter ▪ Transorb for surge suppression ▪ Analog to Digital converter
Analog Outputs (AO)	2 on AI/O Module None on AI Module	Each AO supports/includes: ▪ Jumper to configure output for either 4–20mA or 1–5 Vdc ▪ maximum external load to the 4–20mA output of either 250 ohms with an external 11V power source or 650 ohms with an external 24V power source. ▪ maximum external load current to the 1–5 Vdc output is 5 mA with an external 11-30 V power source. ▪ AO operation requires an 11–30Vdc power source connected to the VEXT terminal of the AI/O module.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

Each non-isolated **AI/O** module (general part number **396568-XX-X**) consists of a PCB with six AIs, 2 AOs, and comes with a module cover. There are two configurations:

Table 3-11. Non-Isolated AI/O Module Configurations

Part Number	Termination Connector	Notes
396568-01-7:	local	
396568-02-5:	remote	

Each non-isolated **AI** module (general part number **396569-XX-X**) consists of a PCB with six AIs and comes with a module cover. There are two configurations:

Table 3-12. Non-Isolated AI Module Configurations

Part Number	Termination Connector	Notes
396569-01-3:	local	
396569-02-1:	remote	

Cable Shields

Connect cable shields associated with AI wiring to the ControlWave Micro's housing ground. Multiple shield terminations require that you supply a copper ground bus (up to a #4 AWG wire size) and connect it to the housing's ground lug.

This ground bus must accommodate a connection to a known good earth ground (in lieu of a direct connection from the ground lug) and to all AI cable shields. Shield wires should use an appropriate terminal lug. Secure them to the copper bus using industry rugged hardware (screw/bolt, lock washer, and nuts).

Setting Jumpers

AI/O and AI modules have jumpers you can use to configure each of the six AIs. You can individually configure AIs for 1–5 Vdc or 4–20 mA operation. See *Table 3-13*.

Table 3-13. Jumper Assignments: Non-isolated AI/O and AI Module

Jumper	Purpose	Description
JP1-JP6	Configures AI1 through AI6 (respectively)	Pins 1-2 installed = 4-20 mA AI Pins 2-3 installed = 1-5 V AI
JP7[1]	AO1 Field Output	Pins 1-2 installed = 4-20 mA AO Pins 2-3 installed = 1-5 V AO
JP8[1]	AO2 Field Output	Pins 1-2 installed = 4-20 mA AO Pins 2-3 installed = 1-5 V AO
JP9[1]	AO1 Calibration Test	Pins 1-2 installed = 1-5 V AO Pins 2-3 installed = 4-20 mA AO
JP10[1]	AO2 Calibration Test	Pins 1-2 installed = 1-5 V AO Pins 2-3 installed = 4-20 mA AO
JP1	Configures ISP Connector	**Reserved for factory use only**
W1	Programs Serial EEPROM	**Reserved for factory use only**

1 Configuration for JP7 and JP9 must match (that is, both 1-5 V or 4-20mA)
Configuration for JP8 and JP10 must match (that is, both -5 V or 4-20mA)

Wiring the Module

Figure 3-11 shows field wiring assignments associated with the locally terminated AI/O and AI modules. *Figure 3-12* shows field wiring assignments associated with remotely terminated AI/O and AI modules.

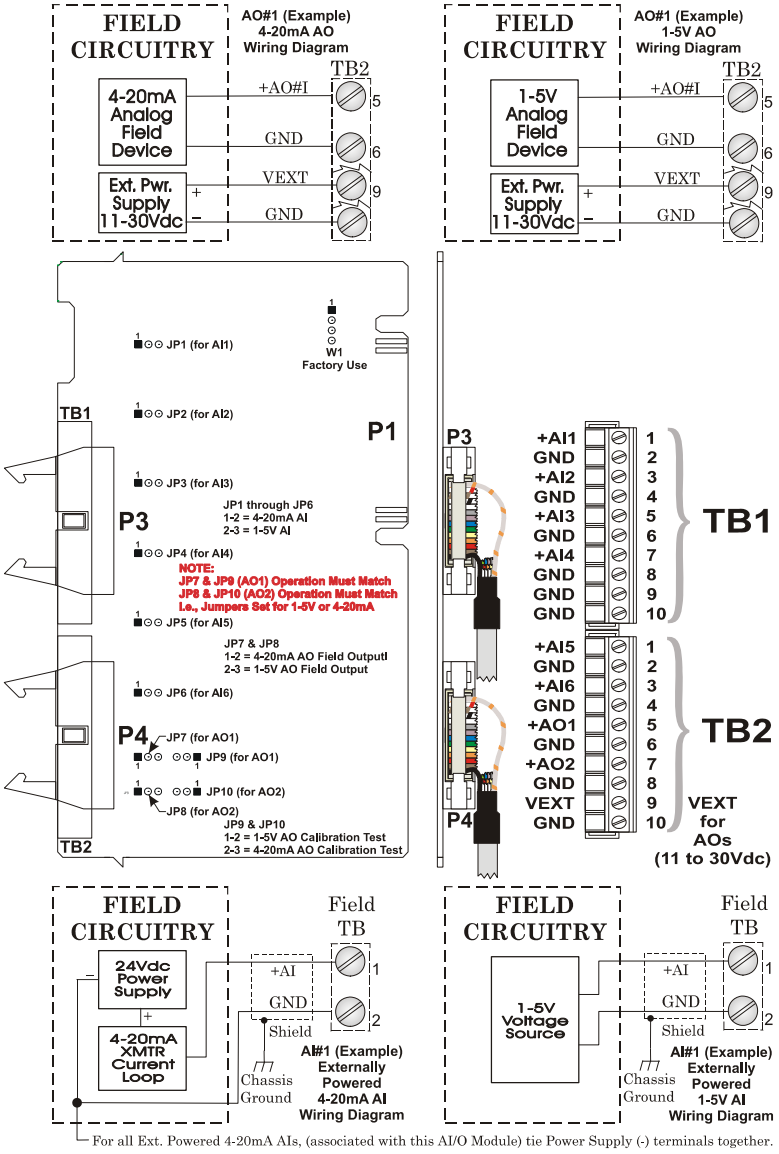


Figure 3-11. Non-isolated AI/O and AI Module Configuration (Local Termination)

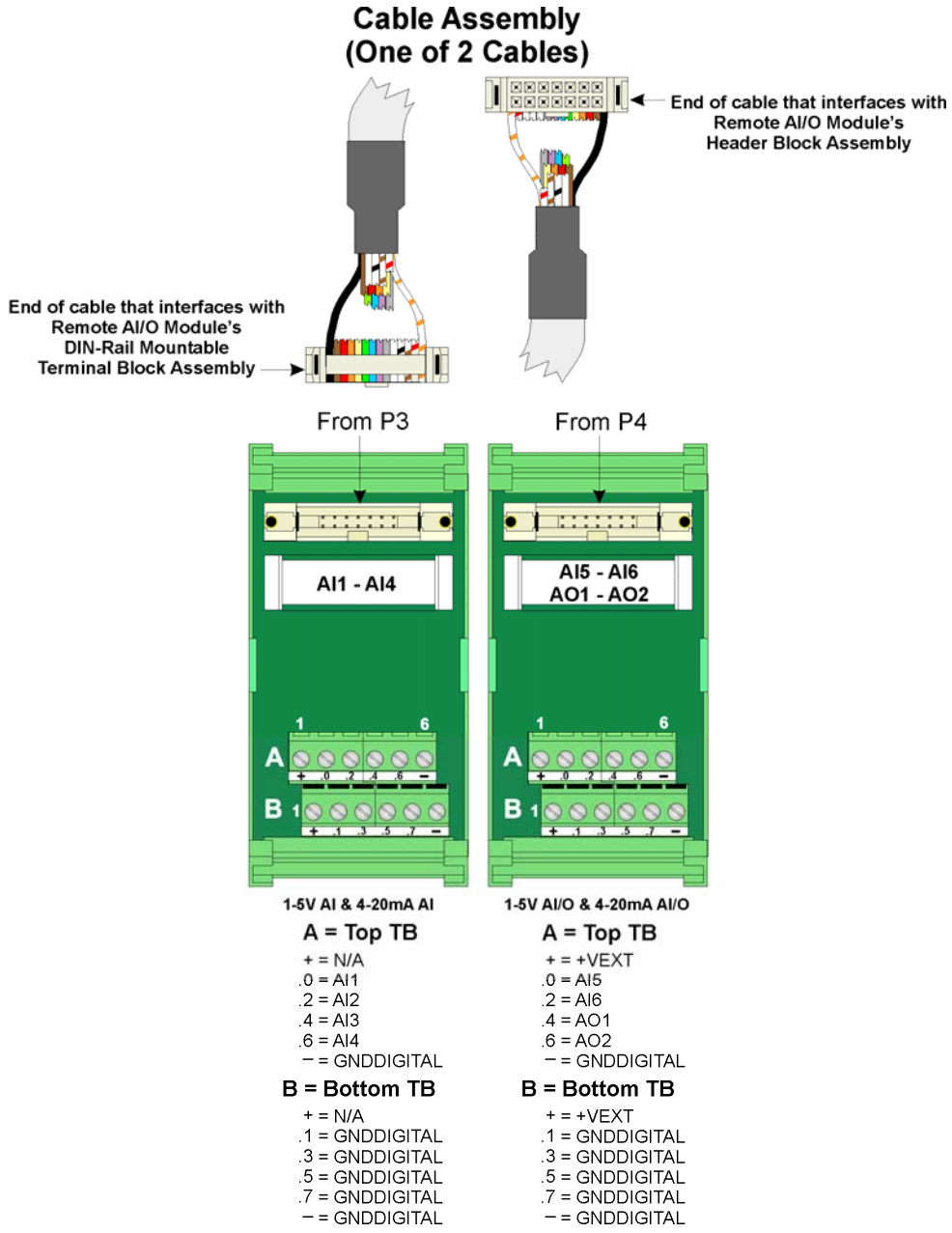


Figure 3-12. Non-isolated AI/O and AI Modules (Remote Termination)

Software Configuration

To use data from a non-isolated AI/O module you must add a **CWM_MA** board in ControlWave Designer's I/O Configurator, and then configure it. To use data from a non-isolated AI module you must add a **CWM_AI6** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for these modules.

3.7 Non-isolated High Speed Counter (HSC) Input Module

Non-isolated High Speed Counter (HSC) Input modules provide up to four inputs. You can individually configure HSC module inputs for either a 10 KHz (high speed) or 300 Hz (low speed) input, and as a 16-bit high speed counter

HSC modules consist of a HSC PCB with two 10-point terminal block assemblies (for local termination) or two 14-pin mass termination headers (for remote termination), 14 configuration jumpers, an LED daughter board with four status LEDs (one for each point), and a cover assembly. The HSC PCM connects with the backplane using a 36-pin gold-plated card-edge connector.

Table 3-14. High Speed Counter Module General Characteristics

Type	Number Supported	Characteristics
High Speed Counter Inputs (HSC)	4	Each HSC supports/includes: ▪ Jumper to configure point as either a low speed input (300 Hz) or a high speed input (10 KHz). ▪ Jumper to configure HSC current. ▪ Bandwidth limiting ▪ Surge suppression ▪ Field inputs can be driven by signals or relay contacts. ▪ LED status indicator

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

The non-isolated HSC module (general part number **396570-XX-X**) has the following configurations:

Table 3-15. High Speed Counter Module Configurations

Part Number	Termination Connector	Notes
396570-05-4:	local	
396570-06-2:	remote	

Setting Jumpers

HSC modules support up to four HSC inputs. Configure the HSC jumpers (W1 through W14) according to *Table 3-16*.

Table 3-16. Jumper Assignments: Non-isolated HSC Module

Jumper	Purpose	Description
W1 – W4	Configures HSC1 through HSC4 (respectively)	Pins 1-2 installed = Enables 300 Hz (low speed input) Pins 2-3 installed = Enables 10 KHz (high speed input)

Jumper	Purpose	Description
W5	Programs Serial EEPROM	**Reserved for factory use only**
W6	Enables LEDs	Pins 1-2 installed = Enables LEDs manually Pins 2-3 installed = Enables LEDs via software
W7 & W8	Controls HSC1 Current	Pins 1-2 installed = Enables additional 2 mA load Pins 2-3 installed = Enables 200 uA source; no 2 mA load
W9 & W10	Controls HSC2 Current	Pins 1-2 installed = Enables additional 2 mA load Pins 2-3 installed = Enables 200 uA source; no 2 mA load
W11 & W12	Control HSC3 Current	Pins 1-2 installed = Enables additional 2 mA load Pins 2-3 installed = Enables 200 uA source; no 2 mA load
W13 & W14	Controls HSC4 Current	Pins 1-2 installed = Enables additional 2 mA load Pins 2-3 installed = Enables 200 uA source; no 2 mA load

Wiring the Module

Figure 3-13 shows field wiring assignments for the locally terminated HSC module; *Figure 3-14* shows field wiring assignments for the remotely terminated HSC module.

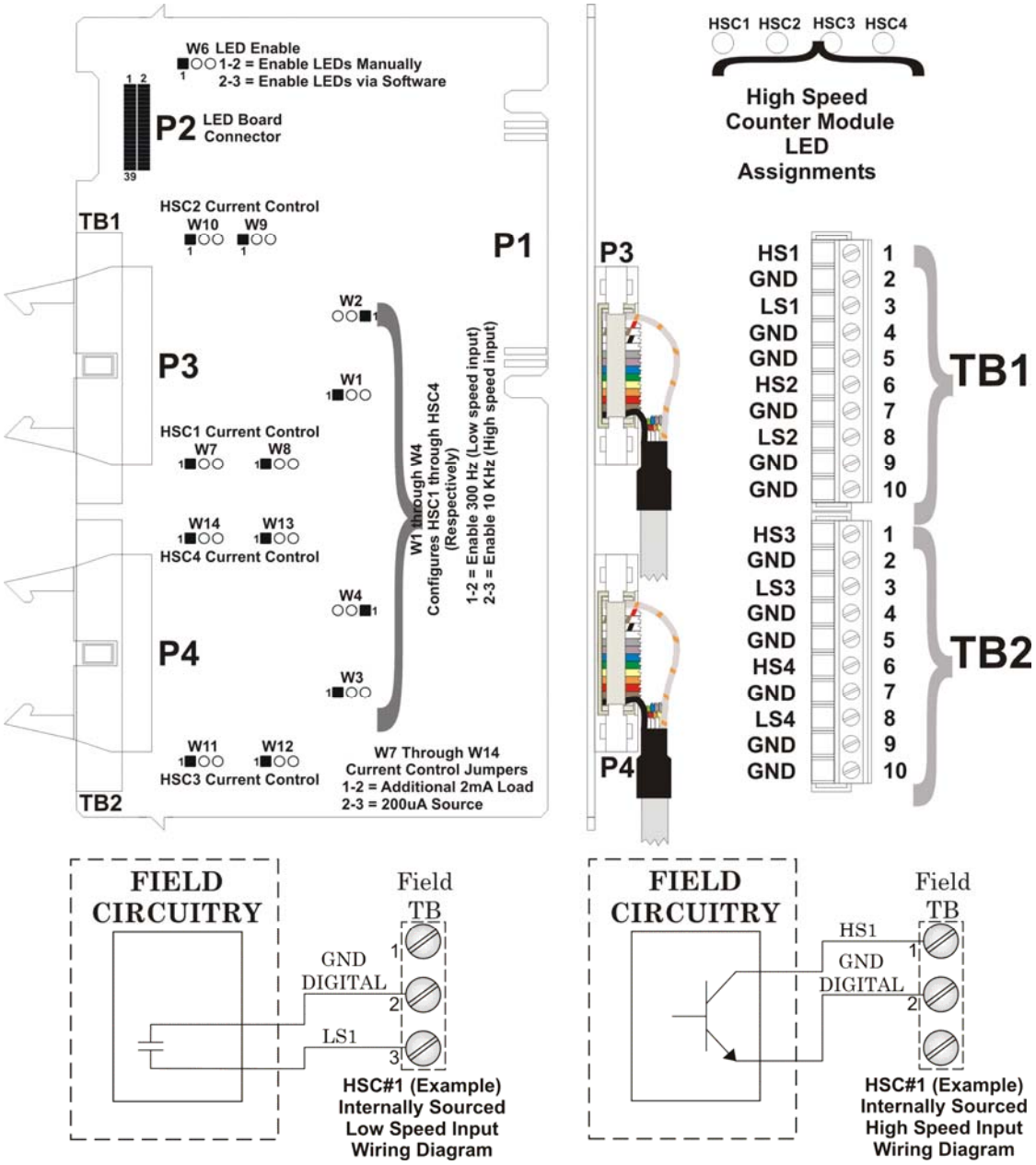
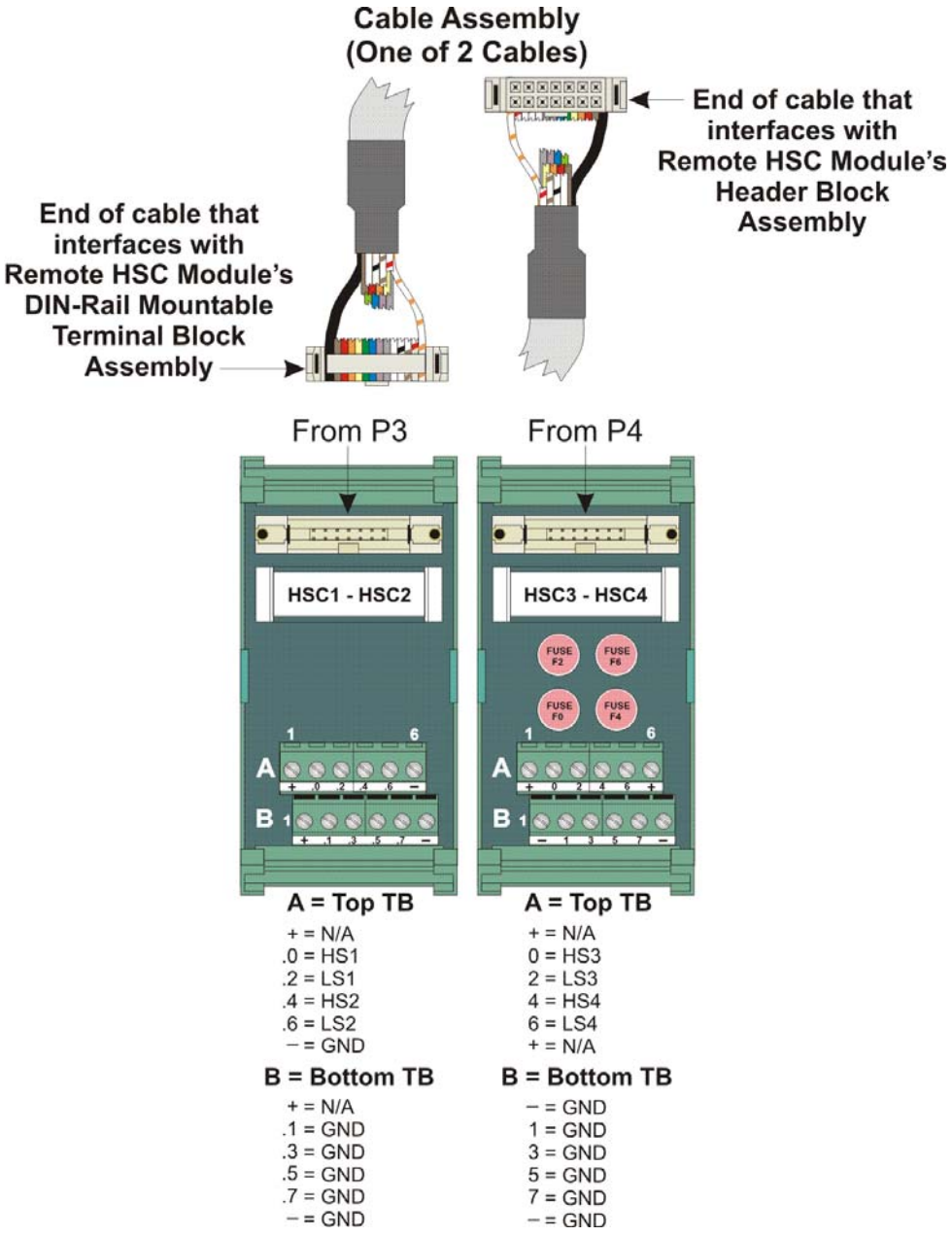


Figure 3-13. Non-isolated HSC Module (Local Termination)



Note: Fuses F0, F2, F4, and F6 are 1/8 A.

Figure 3-14. Non-isolated HSC Module (Remote Termination)

Software Configuration

To use data from a high speed counter module you must add a **CWM_HSC4** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.8 Isolated Analog Input (AI) Module

Isolated AI modules support eight 4–20 mA, 1–5 Vdc, or 0–10 Vdc differential analog inputs.

AI modules consist of an AI PCB with two 10-point terminal block assemblies (for local termination) or two 14-pin mass termination headers (for remote termination), eight configuration jumpers, and a module cover assembly. The AI PCB connects with the backplane using a 36-pin gold-plated card-edge connector.

Table 3-17. Isolated Analog Input (AI) Module General Characteristics

Type	Number Supported	Characteristics
Analog Inputs (AI)	8	Each AI supports/includes: ▪ Jumpers to configure input for either isolated 4–20mA, isolated 1–5 Vdc, isolated 0–10 Vdc, or non-isolated internally powered 4-20mA current loop operation. ▪ AIs configured as isolated inputs have a common mode range of ±180V ▪ Analog input circuitry isolated from bus interface

Cable Shields

Connect cable shields associated with AI wiring to the ControlWave Micro's housing ground. Multiple shield terminations require that you supply a copper ground bus (up to a #4 AWG wire size) and connect it to the housing's ground lug.

This ground bus must accommodate a connection to a known good earth ground (in lieu of a direct connection from the ground lug) and to all AI cable shields. Shield wires should use an appropriate terminal lug. Secure them to the copper bus using industry rugged hardware (screw/bolt, lock washer, and nuts).

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

The isolated Analog Input (AI) module (general part number **396604-XX-X**) has the following configurations:

Table 3-18. Isolated Analog Input Module Configurations

Part Number	Termination Connector	Notes
396604-03-0	local	
396604-04-8	remote	

Setting Jumpers

AI modules have jumpers you can use to configure each of the eight AIs. You can individually configure AI for 4–20 mA, 1–5 Vdc, or 0–10 Vdc isolated operation or internally sourced 4–20 mA non-isolated operation. See *Table 3-19* for settings.

Table 3-19. Jumper Assignments: Isolated AI Module

Jumper	Purpose	Description
W1 – W8	Configures AI1 through AI8 (respectively)	Voltage Input AIs use two dual-pin jumpers Isolated Current AIs use three dual-pin connectors Internally sourced AIs use four dual-pin jumpers See *Figure 3-15* and *Figure 3-16* for examples of how to use these jumpers.
W9	Programs Serial EEPROM	**Reserved for factory use only**

Wiring the Module

Figure 3-15 shows terminal assignments for a locally terminated AI module; *Figure 3-16* shows terminal assignments for a remotely terminated AI.

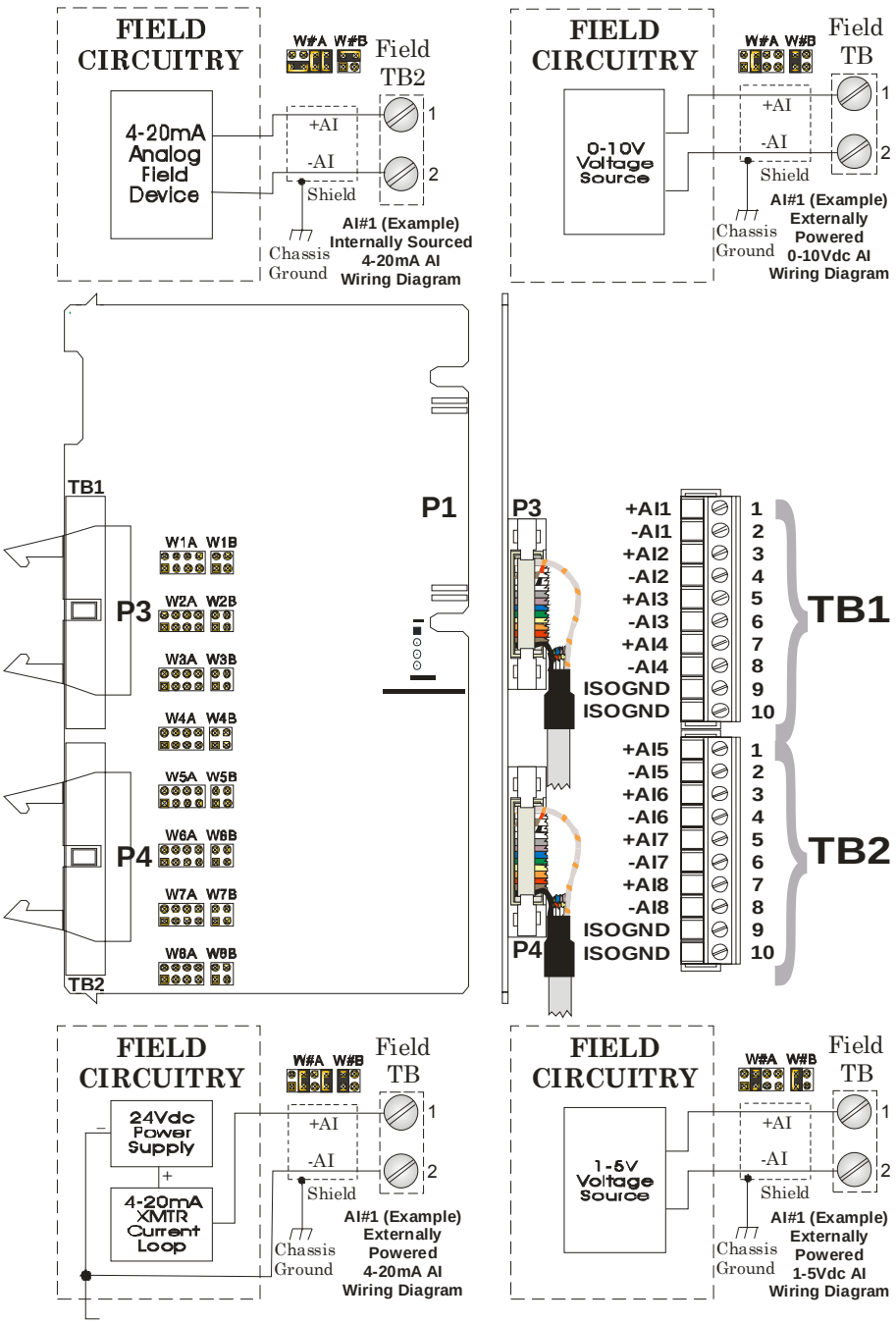
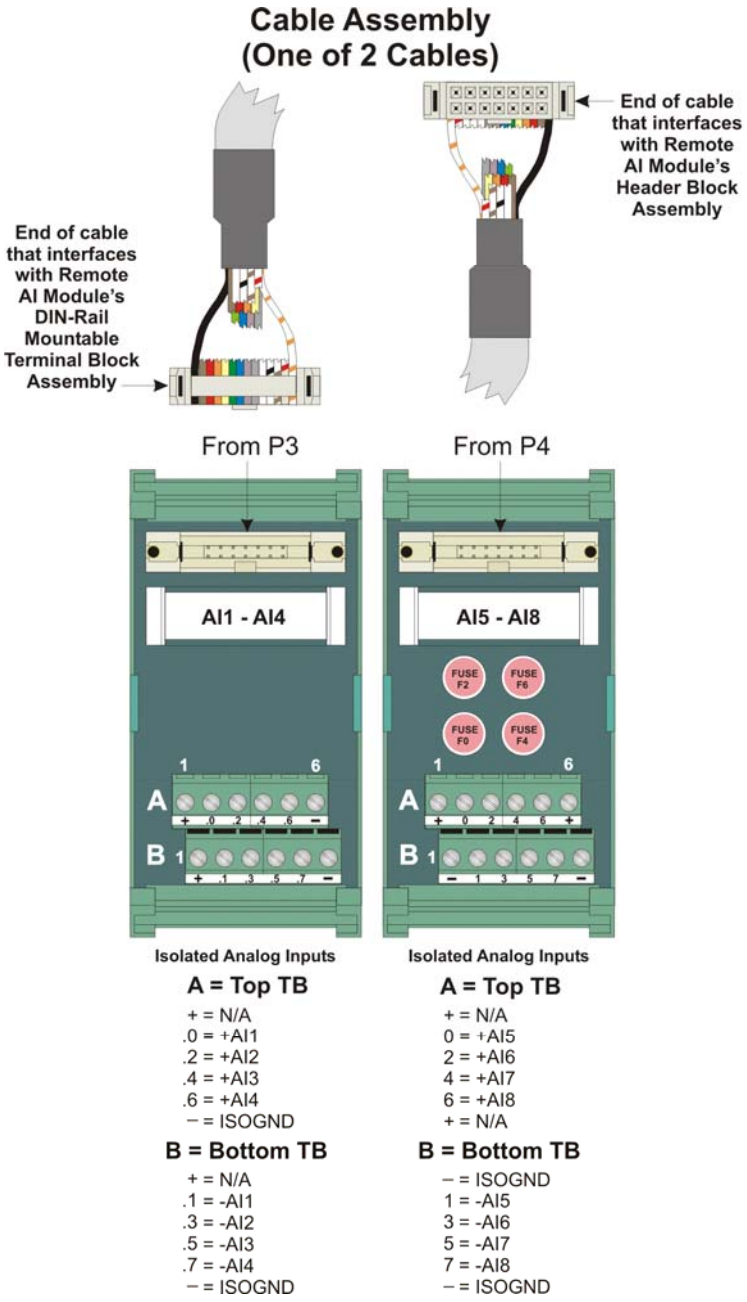


Figure 3-15. Isolated AI Module (Local Termination)



Note: Fuses F0, F2, F4, and F6 are 1/8 A.

Figure 3-16. Isolated AI Module (Remote Termination)

Software Configuration

To use data from an isolated analog input module you must add a **CWM_AI8** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.9 Isolated Analog Output (AO) Module

AO modules support four independently configurable 4–20 mA or 1–5 Vdc isolated analog outputs. Analog output circuitry is electrically isolated from the CPU power system.

AO modules consist of an AO PCB with two 10-point terminal block assemblies (TB1 and TB2 for local termination) or two 14-pin mass termination headers (P2 and P3 for remote termination), four configuration jumpers, and a module cover. The AO PCB connects to the backplane using a 36-pin gold-plated card-edge connector.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configurations

The isolated Analog Output module (general part number **396603-XX-X**) has the following configurations:

Table 3-20. Isolated Analog Output Module Configurations

Part Number	Termination Connector	Notes
396603-01-7	local	
396603-02-5	remote	

Setting Jumpers

AO modules have jumpers you can use to configure each of the four AOs. You can individually configure each AO for 4–20 mA or 1–5 Vdc isolated operation. See *Table 3-21*.

Table 3-21. Jumper Assignments: Isolated AO Module

Jumper	Purpose	Description
JP1	Configures AO1	Pins 1-2 installed = Voltage output Pins 2-3 installed = Current output
JP2	Configures AO2	Pins 1-2 installed = Voltage output Pins 2-3 installed = Current output
JP3	Configures AO3	Pins 1-2 installed = Voltage output Pins 2-3 installed = Current output
JP4	Configures AO4	Pins 1-2 installed = Voltage output Pins 2-3 installed = Current output

Wiring the Module

Figure 3-17 shows field wiring assignments for a locally terminated AO module. *Figure 3-18* shows field wiring assignments for a remotely terminated AO module.

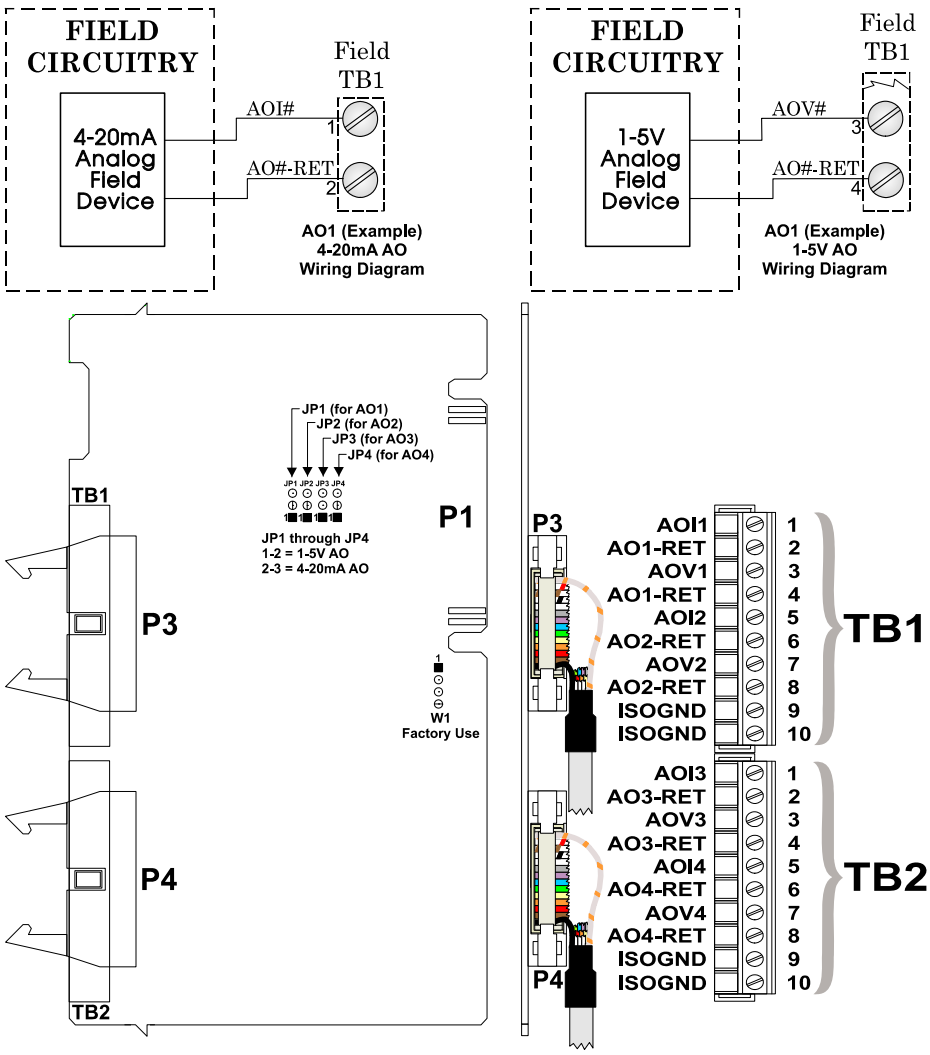
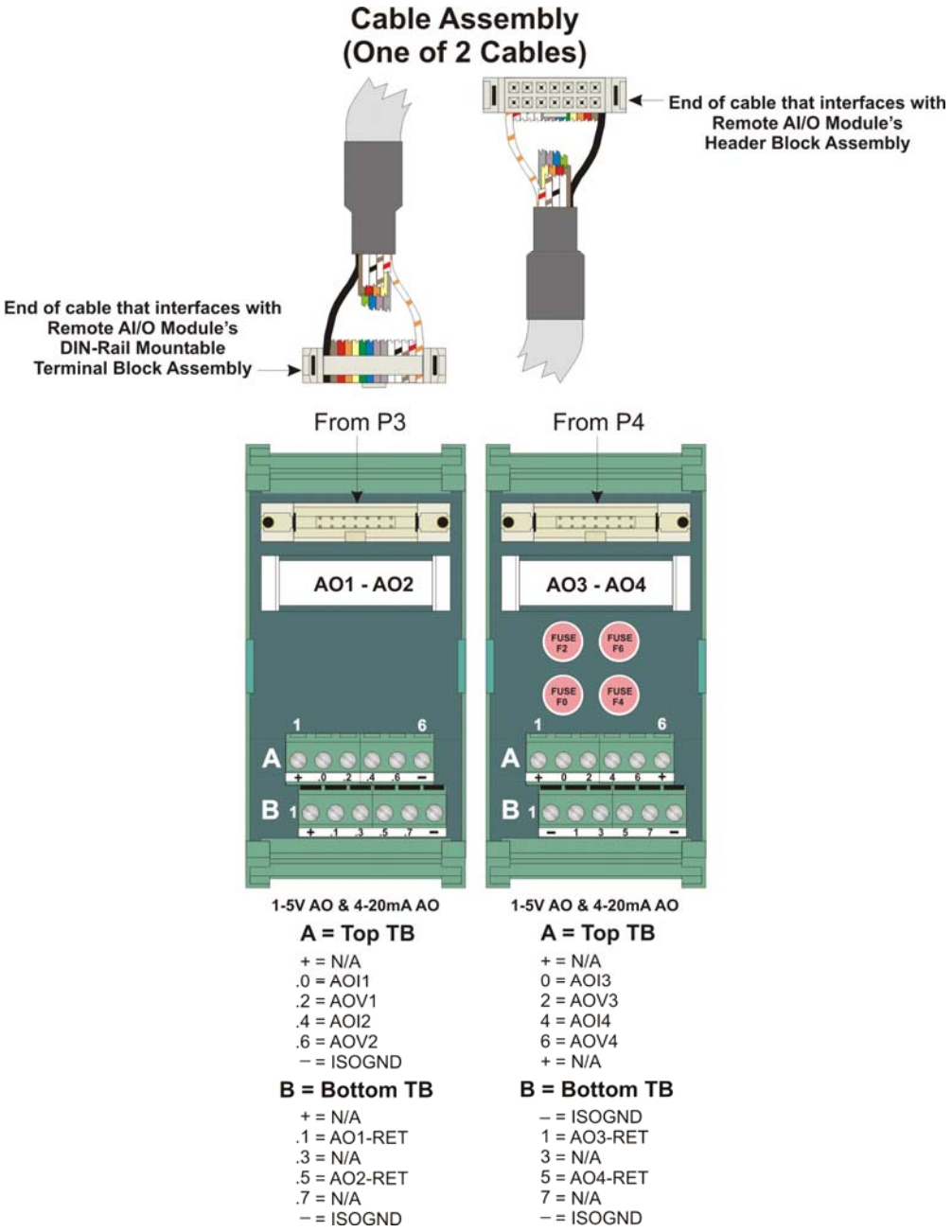


Figure 3-17. Isolated AO Module (Local Termination)



Note: Fuses F0, F2, F4, and F6 are 1/8 A.

Figure 3-18. Isolated AO Module (Remotely Terminated)

Software Configuration

To use data from an isolated analog output module you must add a **CWM_AO4** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.10 Non-isolated Mixed I/O (MI/O) Module

Non-isolated Mixed I/O (MI/O) modules provide up to six individually field configurable DI/Os, four AIs, two HSC Inputs and, optionally, one AO.

MI/O modules consist of an MI/O PCB with two 10-point terminal block assemblies (TB1 and TB2 for local termination) or two 14-pin mass termination headers (P2 and P3 for remote termination), 28 configuration jumpers, and a module cover. The MI/O PCB connects to the backplane using a 36-pin gold-plated card-edge connector.

Note: I/O circuitry is identical to circuitry used on other I/O modules.

HSC inputs have surge suppression, bandwidth limiting and 20 microsecond (50kHz) filtering. You can individually field-configure HSC inputs for 2mA or 200uA (low power) operation. Each input of the HSCI Module is configured as a 16-bit high-speed counter.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Optional AO

Optionally, certain configurations of MI/O modules can also support one externally powered (VEXT = 11–30 Vdc) analog output.

AO circuitry consists of a 12-bit resolution Digital-to-Analog Converter (DAC).

Configurations

The non-isolated Mixed I/O (MI/O) module (general part number **396630-XX-X**) has the following configurations:

Table 3-22. Mixed I/O Module Configurations

Part Number	I/O Included	Termination Connector	Notes
396897-01-0	4AI, 2HSC, 6DI/DO	local	includes LED daughterboard
396897-02-9	4AI, 2HSC, 6DI/DO & 1AO (on daughterboard)	local	includes LED daughterboard
396897-03-7	4AI, 2HSC, 6DI/DO	remote	includes LED daughterboard
396897-04-5	4AI, 2HSC, 6DI/DO & 1AO (on daughterboard)	remote	includes LED daughterboard

Setting Jumpers

MI/O modules have 28 jumpers you can use to configure each input or output. See *Table 3-23.*

Table 3-23. Jumper Assignments: Non-isolated MI/O Module

Jumper	Purpose	Description
W1[1]	Configures optional AO for voltage or current output	Pins 1-2 installed = Sets AO for current output Pins 2-3 installed = Sets AO for voltage output
W2	Configures optional AO for voltage or current output	Pins 1-2 installed = Sets AO for voltage output Pins 2-3 installed = Sets AO for current output
W3	Enables DI/DO status LEDs	Pins 1-2 installed = Enables LEDs manually Pins 2-3 installed = Enables LEDs via software
W4	Enables HSC status LEDs	Pins 1-2 installed = Enables LEDs manually Pins 2-3 installed = Enables LEDs via software
W5 & W6	Controls HSC1 Current	Pins 1-2 installed = Permits additional 2 mA load Pins 2-3 installed = Permits 200 uA source; no 2 ma load
W7 & W8	Controls HSC2 Current	Pins 1-2 installed = Permits additional 2 mA load Pins 2-3 installed = Permits 200 uA source; no 2 ma load
W9 & W10	Configures HSC1 and HSC2 debounce (respectively)	Pins 1-2 installed = Enables HSC debounce Pins 2-3 installed = Disabled HSC debounce
W11-W16	Configures DI1 through DI6 current (respectively)	Pins 1-2 installed = Sets 2 mA source current Pins 2-3 installed = Sets 60 uA source current
W17-W22	Select DI/O1 through DI/O6 points (respectively)	Pins 1-2 installed = Sets digital input operation Pins 2-3 installed = Sets digital output operation
W23-W26	Configures AI1 through AI4 (respectively)	Pins 1-2 installed = 4–20 mA AI (250Ω resistor in) Pins 2-3 installed = 1–5 Vdc AI
W27[2]	Selects AO Voltage	Pins 1-2 installed = N/A Pins 2-3 installed = External Field Voltage (TB2-9)
W28	Enables HSC Circuitry	Pins 1-2 installed = Enable (power) HSC circuit Pins 2-3 installed = Disable HSC circuit

1 W1 jumper located on optional AO daughterboard.
2 Set W27 **always** to pins 2-3.

Wiring the Module

Figure 3-19 shows field wiring assignments for a locally terminated MI/O module. *Figure 3-20* shows field wiring assignments for a remotely terminated MI/O module.

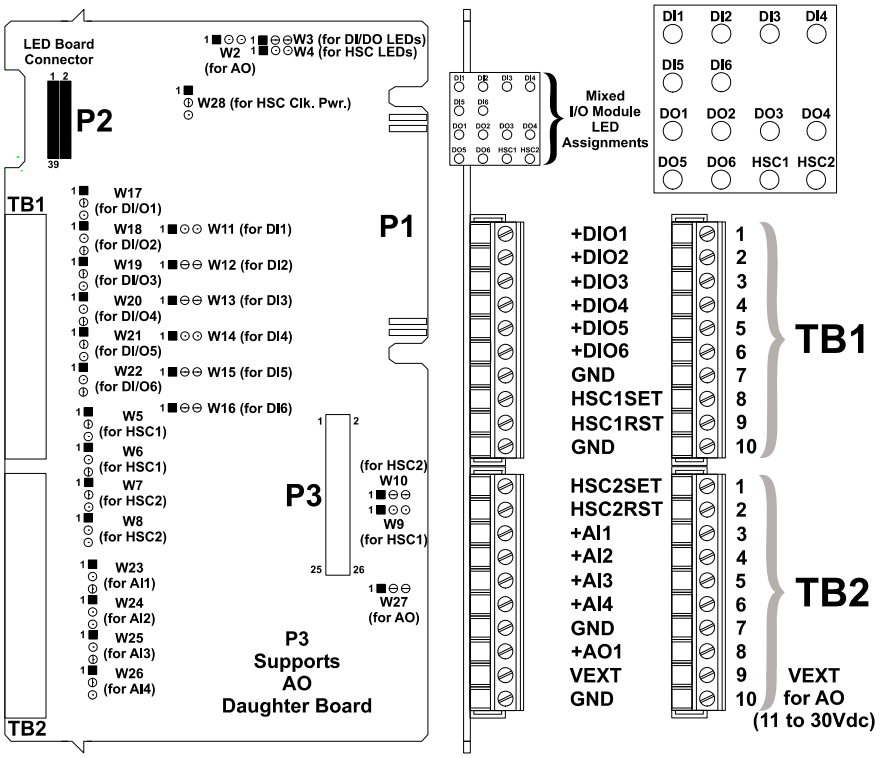


Figure 3-19. Non-isolated MI/O Module (Local Termination)

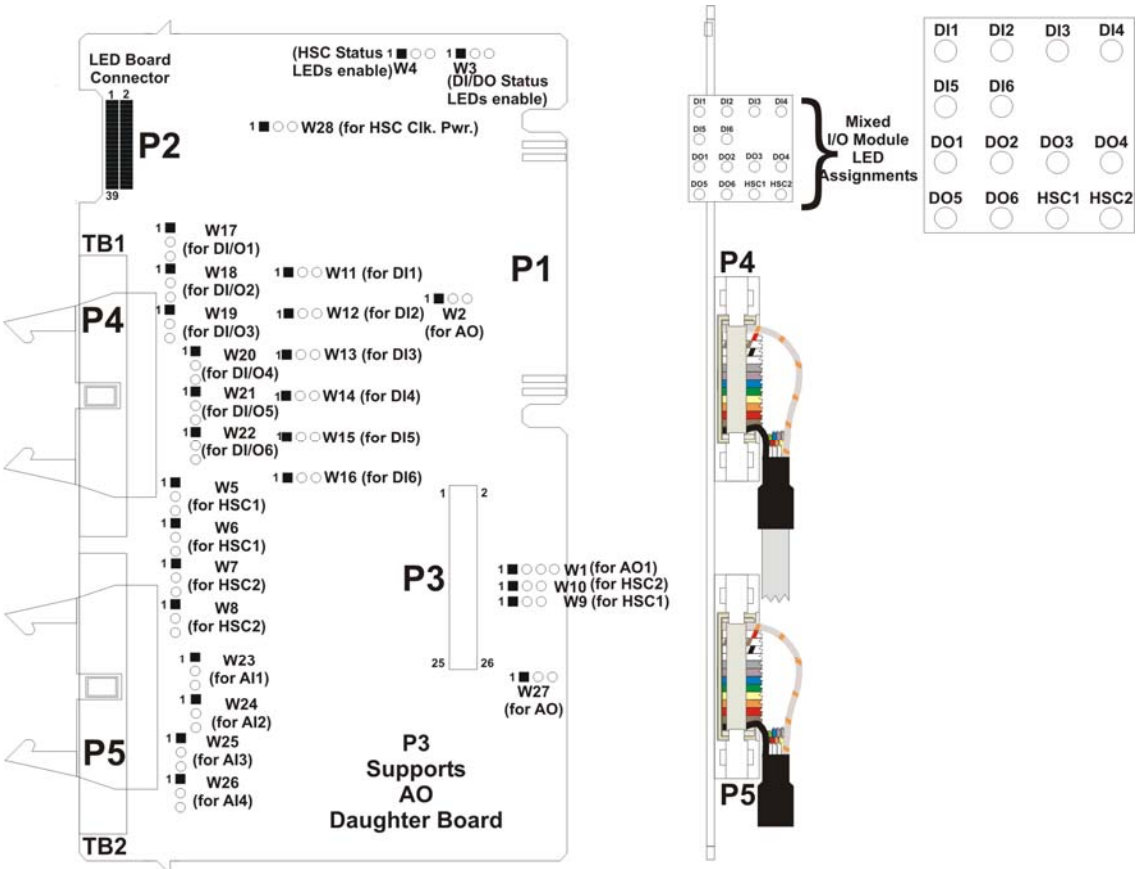
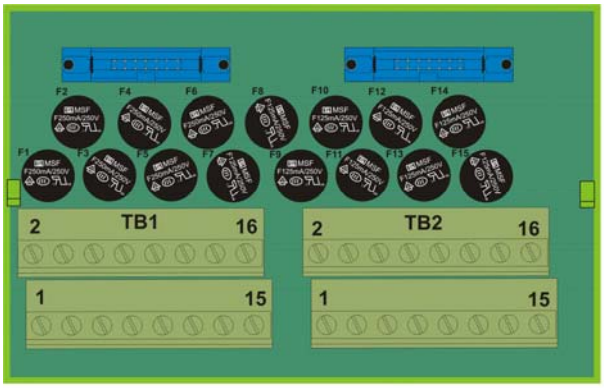


Figure 3-20. Non-isolated MI/O Module (Remote Termination)

Figure 3-21 shows terminal block assignments for remote termination. *Figure 3-22* shows a wiring diagram for mixed I/O for local termination. *Figure 3-23* shows a wiring diagram for mixed I/O for remote termination.



TB1 -1, 3, 5, 7, 9, 11, 13, 15	GND	TB2 -1, 3, 5, 7, 9, 11, 13, 15	GND
TB1 -2	DI/O 1	TB2 -2	HSC2SET
TB1 -4	DI/O 2	TB2 -4	HSC2RST
TB1 -6	DI/O 3	TB2 -6	AI 1
TB1 -8	DI/O 4	TB2 -8	AI 2
TB1 -10	DI/O 5	TB2 -10	AI 3
TB1 -12	DI/O 6	TB2 -12	AI 4
TB1 -14	HSC1SET	TB2 -14	AO
TB1 -16	HSC1RST	TB2 -16	VEXT

Note: Fuses F1 to F6 are ¼ A; fused F7 to F15 are 1/8 A.

Figure 3-21. MI/O Module (Remote Termination)

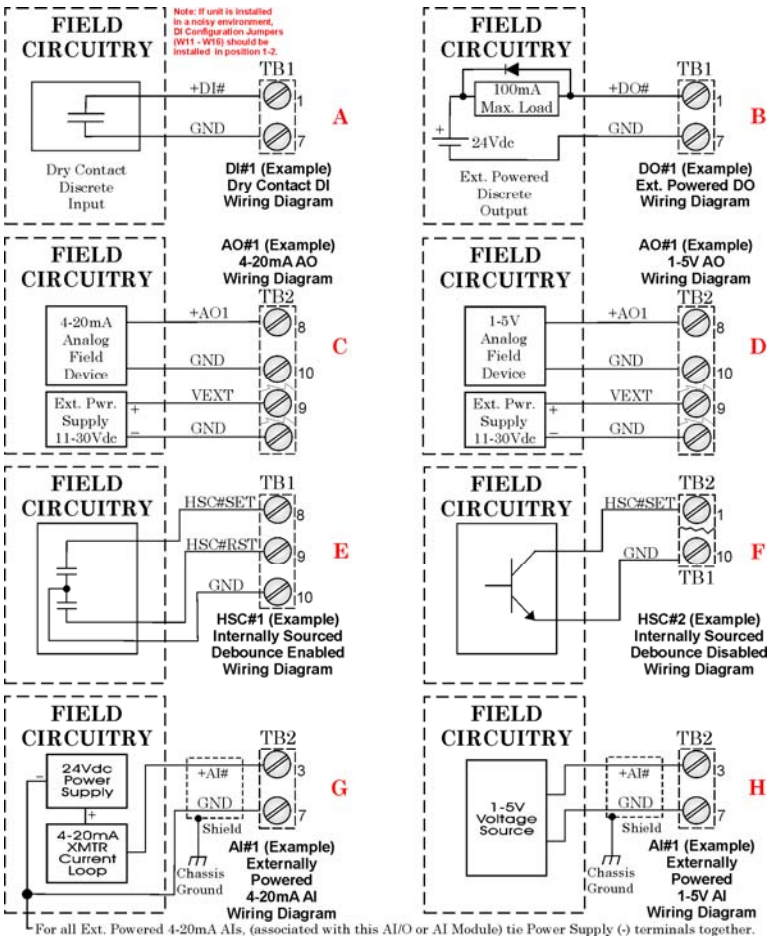


Figure 3-22. MI/O Module Wiring (Local Termination)

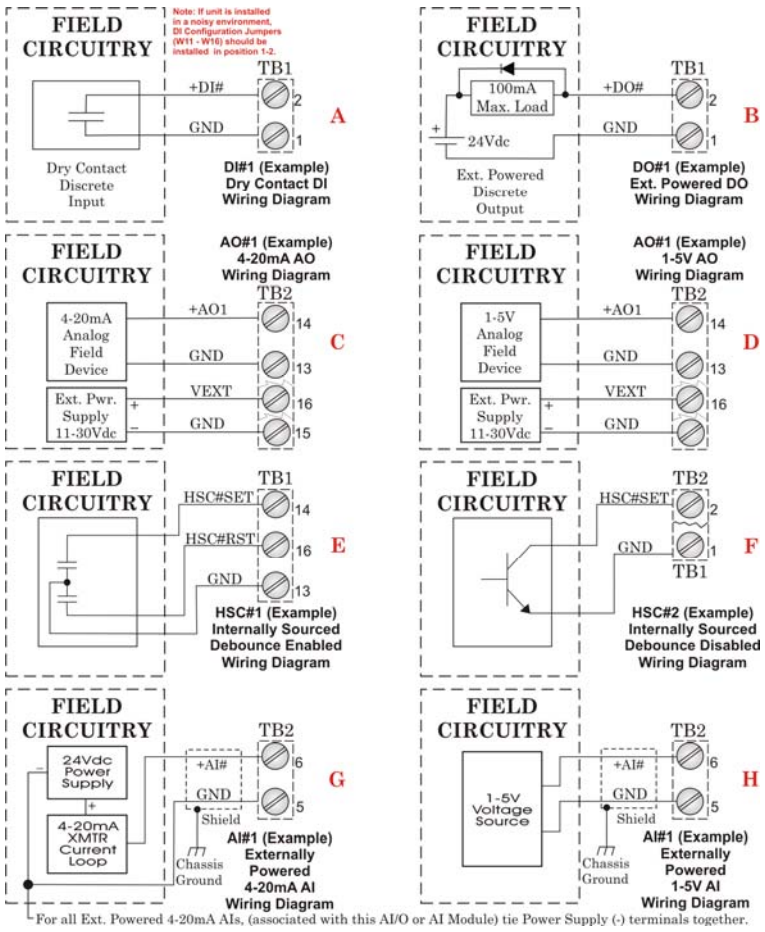


Figure 3-23. MI/O Module Wiring (Remote Termination)

Software Configuration

To use data from a mixed I/O module you must add a **CWM_MIX** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.11 Isolated Vac Digital Input Module

Isolated Vac DI modules provide eight isolated DIs, which can interface to field-powered devices providing 110 Vac or 220 Vac.

Table 3-24. Isolated Vac DI Module General Characteristics

Type	Number Supported	Characteristics
Isolated Digital Inputs (DI)	8	Each DI supports/includes: ▪ Nominal field powered input voltage of 110Vac or 220Vac ▪ Nominal input current of 12mA @ 120Vac ▪ 30 ms input filtering ▪ LED that turns ON when DI is ON.

Vac DI modules consists of a DI PCB with two 10-point terminal block assemblies (for local termination), one configuration jumper, an LED daughterboard with eight status LEDs (one for each point), and a module cover. The Vac DI PCB connects with the backplane using a 36-pin gold-plated card-edge connector.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configuration

The isolated Vac DI module is available in a single configuration (part number **396686-01-0**):

Isolation

Optocouplers electrically isolate the module's DI field circuitry from the module's bus interface circuitry.

Setting Jumpers

Vac DI module has one jumper which enables the DI status LEDs. See *Table 3-25.*

Table 3-25. Jumper Assignments: Isolated Vac DI Module

Jumper	Purpose	Description
W1	Enables DI status LED	Pins 1-2 installed = Enables LEDs manually Pins 2-3 installed = Enables LEDs via software

Wiring the Module

Figure 3-24 shows field wiring assignments for a locally terminated Vac DI module.

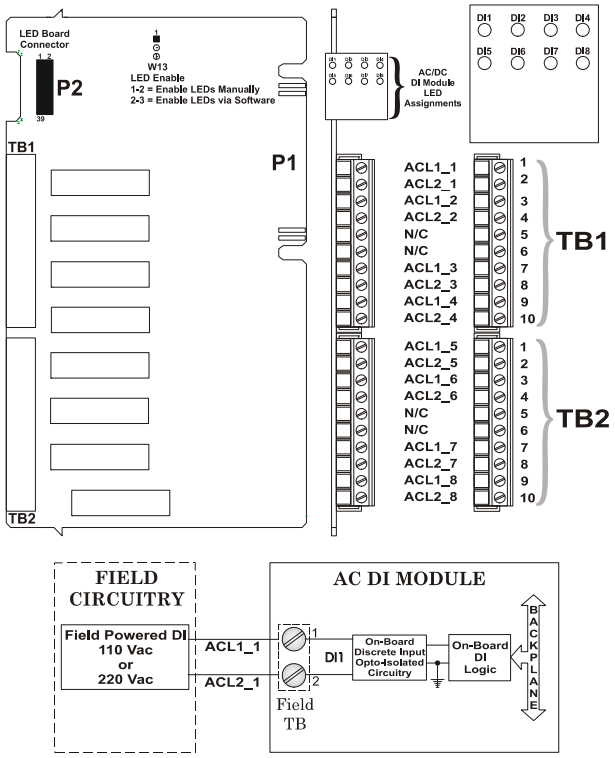


Figure 3-24. Isolated Vac DI Module Wiring (Local Termination)

Software Configuration

To use data from an Isolated Vac Digital Input module you must add a **CWM_DI16** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.12 Relay Isolated Vac/Vdc Digital Output Module

Caution **You cannot install a relay isolated Vac/Vdc DO module in slot #1 of any expansion housing.**

Relay isolated Vac/Vdc DO modules provide a total of eight isolated DOs to control signaling functions. The DOs do **not** have surge protection (this is a customer-provided feature, if necessary).

Table 3-26. Relay Isolated Vac/Vdc DO Module Characteristics

Type	Number Supported	Characteristics
Relay Isolated Digital Outputs (DO)	8	Each DO supports/includes: ▪ A pair of Normally Open (NO) relay contacts capable of handling a maximum operating load of 6A at 240 Vac or 5A at 30Vdc. ▪ Output relay provides 500 Vdc electrical isolation for the DO. ▪ Maximum operating frequency of 360 operations per hour (under rated load). ▪ LED that turns ON when DO is ON.

Isolated Vac/Vdc DO modules consist of a DO PCB with two 10-point terminal block assemblies (for local termination), one configuration jumper, an LED daughterboard with eight status LEDs (one for each point), and a module cover. The DO PCB connects with the backplane using a 36-pin gold-plated card-edge connector.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Isolation

Relays electrically isolate the Vac/Vdc DO field circuitry from the module's bus interface circuitry. An onboard DO load register stores output data. At power up the DO load register clears and sets all outputs to "off."

Configuration

The relay isolated Vac/Vdc DO module is available in a single configuration (part number **396687-01-6**).

Setting Jumpers

The Vac/Vdc DO module has one jumper which enables the DI status LEDs. See *Table 3-27*.

Table 3-27. Jumper Assignments: Isolated Vac DI Module

Jumper	Purpose	Description
W1	Enables DO status LED	Pins 1-2 installed = Enables LEDs manually Pins 2-3 installed = Enables LEDs via software

Wiring the Module

Figure 3-25 shows field wiring assignments for a locally terminated relay isolated Vac/Vdc DO module.

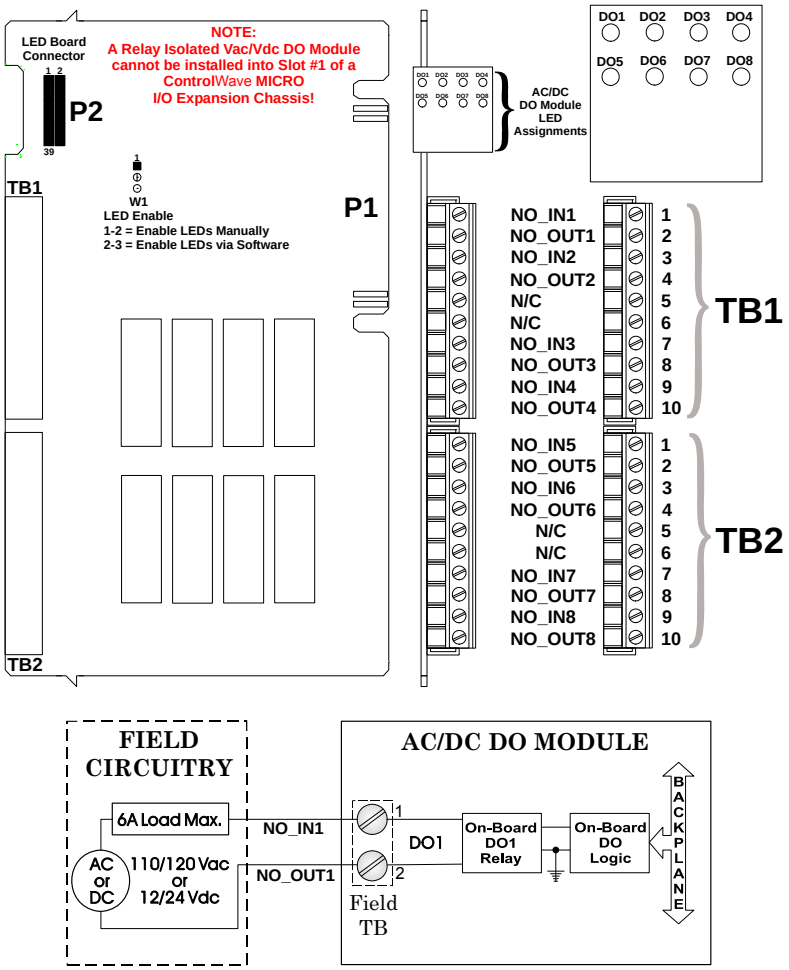


Figure 3-25. Relay Isolated Vac/Vdc DO Module Wiring (Local Termination)

Software Configuration

To use data from a Relay Isolated Vac/Vdc Digital Output module you must add a **CWM_DO16** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.13 Isolated Digital Input/Output (DI/O) Module

Isolated Digital I/O modules provide four isolated DOs that are externally powered and twelve isolated DIs.

Table 3-28. Isolated (DI/O) Module Characteristics

Type	Number Supported	Characteristics
Isolated Digital Outputs (DO)	4	Each isolated DO supports/includes: ▪ Externally powered. Supports 500mA maximum load (nominally powered from a 10Vdc supply [30Vdc max]_ ▪ Surge protection. ▪ Open source MOSFET drives up to 31Vdc at up to 500mA. ▪ 500Vdc MOV to chassis and 31Vdc MOV (across output) protect each DO. ▪ Maximum operating frequency of 20 Hz.
Isolated Digital Inputs (DI)	12	Each isolated DI supports/includes: ▪ Jumper allows externally powered single end inputs or internally sourced dry contact operation. ▪ Nominal input voltage of 24Vdc. ▪ Nominal input current of 5mA. ▪ 30 ms filtering.

Isolated DI/O modules consist of a DI/O PCB with two 10-point terminal block assemblies (for local termination), 14 configuration jumpers, an LED daughterboard with 16 status LEDs (one for each point), and a module cover. The isolated DI/O PCB connects with the backplane using a 36-pin gold-plated card-edge connector.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configuration

The isolated DI/O module is available in a single configuration (part number **396804-01-2**).

Isolation

Surge suppressors and optocouplers electrically isolate the DI field circuitry from the module's bus interface circuitry.

When configured for use in dry contact applications, all DIs use a built-in +21Vdc field power supply. This is an isolated supply powered by the output of the +VIN power source originating on the PSSM. Use jumper W15 to enable or disable the +21Vdc field power supply.

Each of the four DO circuits contain an optically isolated open source MOSFET with surge suppressor and are capable of handling 500mA @ 30V.

Use jumper W15 to enable power for DIs that are configured for internal power. The nominal input voltage is 24Vdc at 5mA.

Setting Jumpers

The isolated DI/O module has 15 jumpers you can use to configure inputs and outputs. See *Table 3-29.*

Table 3-29. Jumper Assignments: Isolated Vac DI Module

Jumper	Purpose	Description
W1	Configures DI1	Pins 2-3 & 4-5 installed = Permit external power DI Pins 1-2 & 3-4 installed = Permit internal source DI
W2-W12	Configures DI2 through DI12 (respectively)	Pins 2-3 & 4-5 installed = Permit external power DI Pins 1-2 & 3-4 installed = Permit internal source DI
W13	Enables DI/O status LED	Pins 1-2 installed = Enables LEDs manually Pins 2-3 installed = Enables LEDs via software
W14	Programs serial EEPROM	**Reserved for factory use only**
W15[1]	Enables VIN	Pins 1-2 installed = Enable VIN Pins 2-3 installed = Disable VIN

1 Place configuration jumper on pins 1-2 if you configure **any** DI for internally sourced operation.

Wiring the Module

Figure 3-26 shows field wiring assignments for a locally terminated isolated DI/O module.

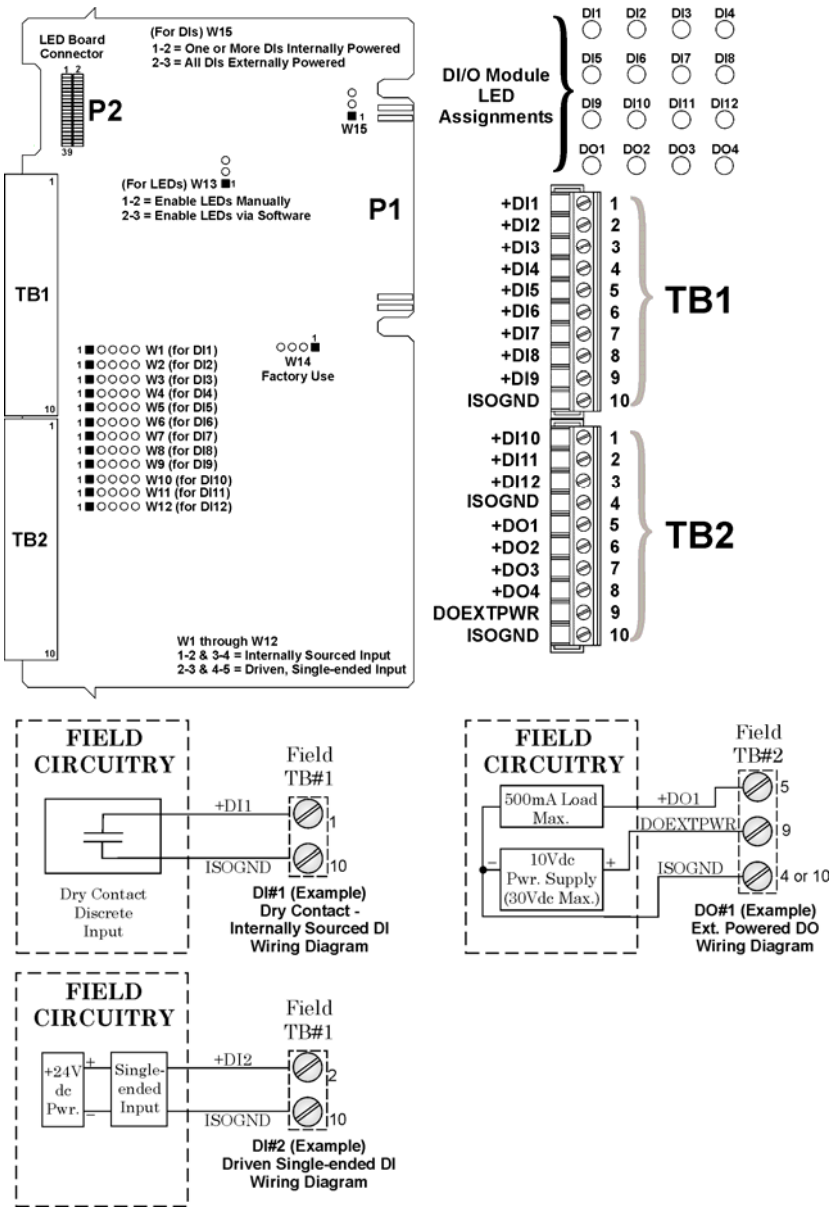


Figure 3-26. Isolated DI/O Module Wiring (Local Termination)

Software Configuration

To use data from an Isolated Digital Input/Output module you must add a **CWM_MD** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.14 Isolated Resistance Temperature Device (RTD) Input Module

RTD Input modules provide a total of four inputs. Firmware detects the RTD type (2-, 3- or 4 platinum wire) via the installation of jumper wires on the terminal block for 2-wire and 3-wire RTDs (see *Figure 3-27*).

Table 3-30. Isolated RTD Input Module General Characteristics

Type	Number Supported	Characteristics
Isolated RTD Input	4	Each isolated RTD input supports/includes: ▪ Signal conditioning circuitry ▪ Surge protection with a 12V transorb that meets IEEE standard 472-1978 ▪ Over voltage protection ▪ 24-bit analog to digital converter (ADC) ▪ Common mode range of 500V with respect to chassis ▪ Electrical isolation of 500Vdc (channel to channel/system bus) ▪ Source current to RTD limited to 330 uA

RTD Input Modules consists of an Isolated RTD Input Board with two 10-point Terminal Block Assemblies (for local termination) or two 14-pin Mass Termination Header Block Assembly (for remote termination), and a Cover Assembly. Each Isolated RTD Board is connected to the unit's Backplane via a 36-pin card edge connector.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configuration

The isolated RTD module (general part number **396876-XX-X**) has the following configurations:

Table 3-31. Isolated RTD Input Module Configurations

Part Number	Termination Connector	Notes
396876-01-3	local	
396876-02-1	remote	

Wiring the Module

Figure 3-27 shows field wiring assignments for locally terminated isolated RTD modules. *Figure 3-28* shows field wiring assignments for remotely terminated isolated RTD modules.

Figure 3-28 also provides wiring diagrams for 2-wire, 3-wire, and 4-wire RTDs to the Local RTD Module Terminal Blocks; wiring assignments, i.e., +RTD#_3/4W, -RTD#_4W, +RTD# and –RTD# are

similar to those assigned to the Remote DIN-Rail Mountable Terminal Blocks.

Note: To maintain specified accuracy with a 3-wire RTD, you must match the two field wires that source and sink the RTD current within 0.01 ohms (matched in length and matched in wire type) and the ambient temperature on these wires must be the same.

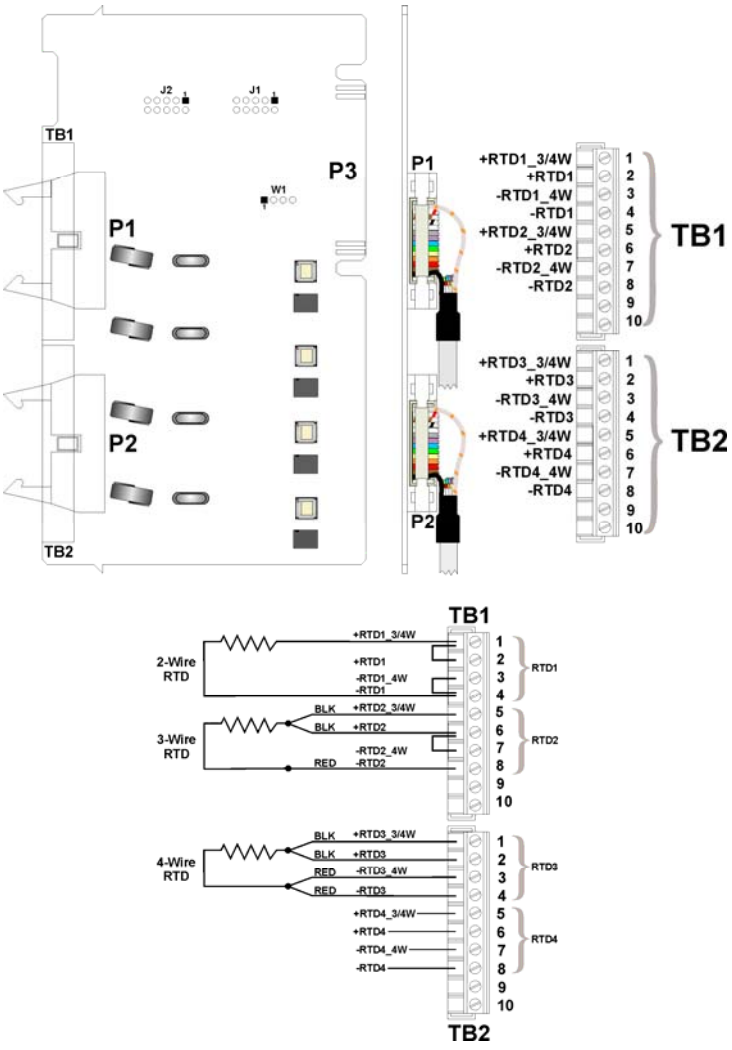


Figure 3-27. Isolated RTD Module Wiring (Local Termination)

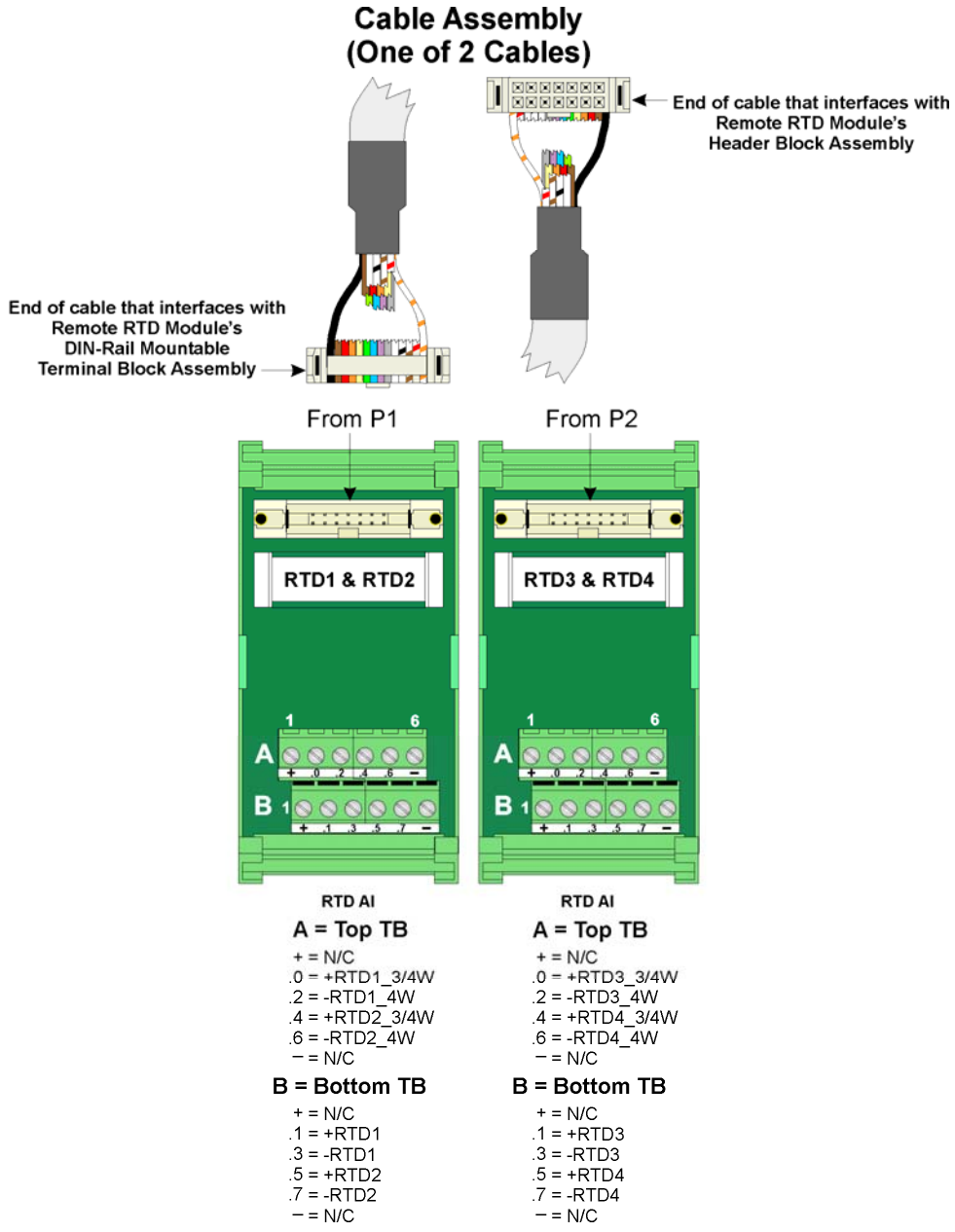


Figure 3-28. Isolated RTD Module Wiring (Remote Termination)

Software Configuration

To use data from an Isolated RTD Input module you must add a **CWM_RTD4** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.15 Isolated Low Level Analog Input (LLAI) Module

Low Level Analog Input (LLAI) modules provide six individually isolated differential inputs for thermocouples or ±10mV inputs plus one cold junction compensation (CJC) input for temperature compensation at the terminal block.

Table 3-32. Isolated LLAI Module Characteristics

Type	Number Supported	Characteristics
Isolated Low Level Analog Input (LLAI)	6	Each isolated LLAI supports/includes: ▪ Signal conditioning circuitry including a 2.5V reference ▪ Surge suppression with a 188V Transorb that meets IEEE standard 472-1978. ▪ Over voltage protection ▪ Opto-isolation circuitry. Each input is provided electrical isolation of 500Vdc (channel to channel/system bus). ▪ 24-bit analog to digital converter (ADC)

The CJC with a built-in RTD provides thermocouple temperature compensation at the terminal block and is electrically isolated. Pins 8, 9 and 10 of the local terminal block (TB1) source and sink the CJC's RTD.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configuration

The isolated LLAI module (general part number **396875-XX-X**) has the following configurations:

Table 3-33. Isolated LLAI Module Configurations

Part Number	Termination Connector	Notes
396875-01-7	local	
396875-02-5	remote	

Wiring the Module

Figure 3-29 shows field wiring for locally terminated isolated LLAI modules. *Figure 3-30* shows field wiring for remotely terminated isolated LLAI modules.

Figure 3-29 also provides diagrams showing the wiring for thermocouples and the 3-wire cold junction compensation (CJC) PCB to a locally terminated LLAI module (that is, +AI#, -AI#, +CJC (Reference), -CJC (Return) & +CJC (Sense) are similar to those assigned to the remote DIN-rail mountable terminal blocks. A small CJC PCB is factory-installed to the terminal block.

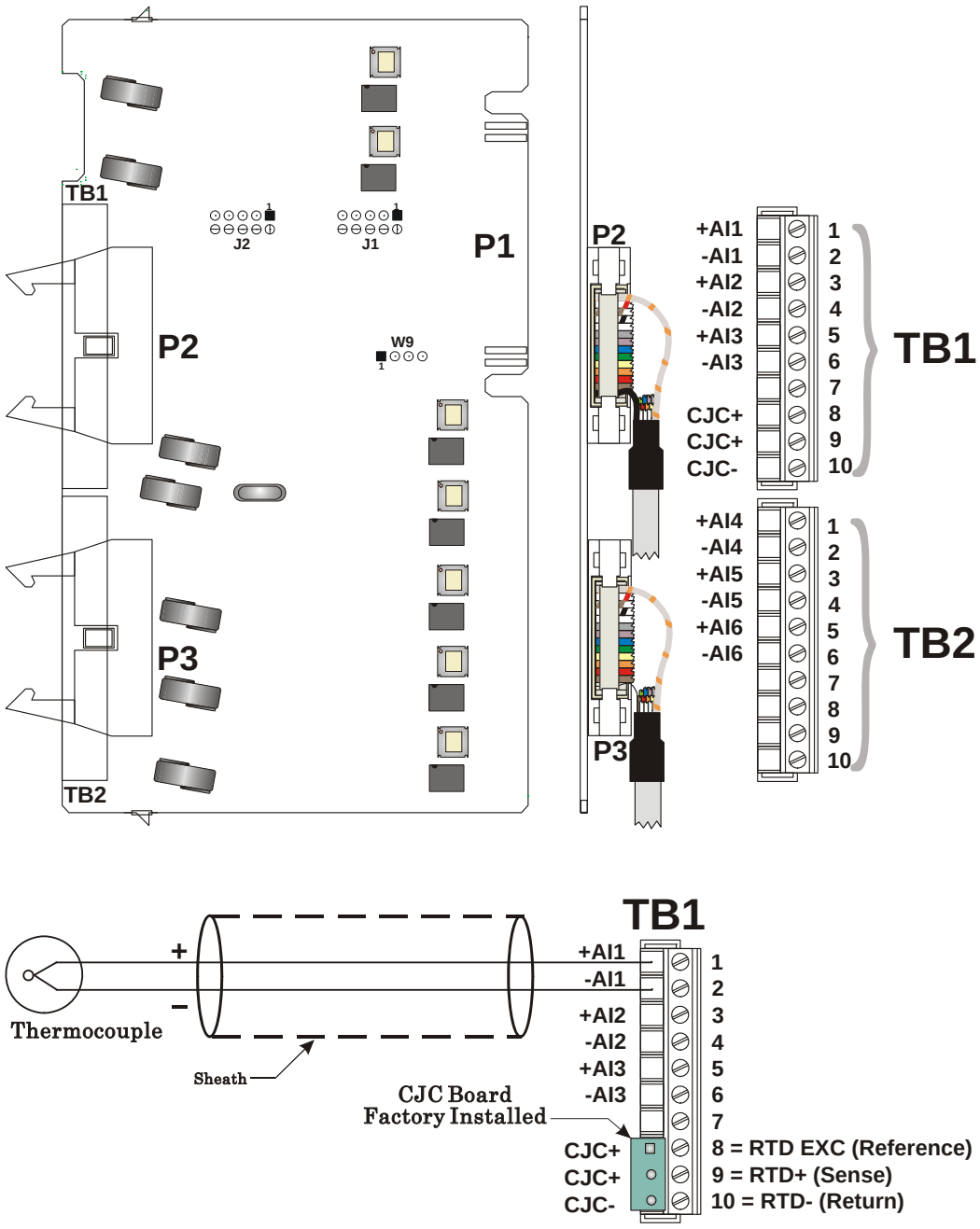


Figure 3-29. Isolated LLAI Module Wiring (Local Termination)

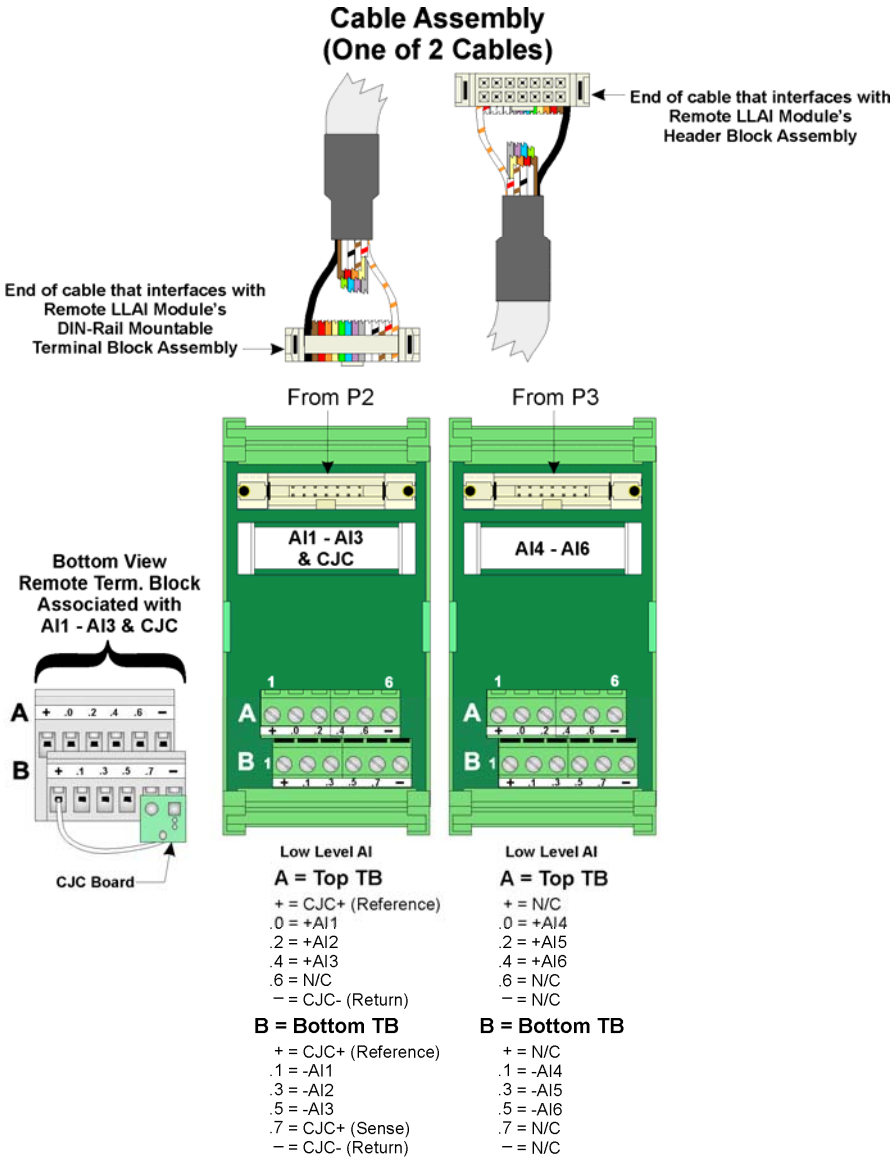


Figure 3-30. Isolated LLAI Module Wiring (Remote Termination)

Ranges & Errors

Table 3-34 provides the accuracy, resolution and temperature range for the various thermocouples and 10mV LLAI inputs. *Table 3-35* lists the RTD errors.

Table 3-34. LLAI Module Input Accuracy and Resolution

Input Type	Accuracy/Range	Resolution	25°C	–20°C to +70°C
B – Thermocouple	100°C to 200°C	2.00°C	± 8°C	± 16°C
	200°C to 390°C	1.00°C	± 4°C	± 8°C
	390°C to 840°C	0.50°C	± 2°C	± 4°C
	840°C to 1820°C	0.20°C	± 1°C	± 2°C
R – Thermocouple	50°C to +50°C	0.40°C	± 2°C	± 4°C
	+50°C to 1720°C	0.17°C	± 1°C	± 2°C
S – Thermocouple	– 50°C to +50°C	0.37°C	± 2°C	± 4°C
	+50°C to 1760°C	0.18°C	± 1°C	± 2°C

Input Type	Accuracy/Range	Resolution	25°C	–20°C to +70°C
C – Thermocouple	0°C to 2315°C	0.16°C	± 0.75°C	± 1.5°C
N – Thermocouple	– 270°C to – 260°C	1.50°C	± 8°C	± 16°C
	– 260°C to – 250°C	0.75°C	± 4°C	± 8°C
	– 250°C to – 230°C	0.50°C	± 2°C	± 4°C
	– 230°C to – 150°C	0.25°C	± 1°C	± 2°C
	– 150°C to 1300°C	0.09°C	± 0.500°C	± 1°C
J – Thermocouple	– 210°C to 191°C	0.08°C	± 0.750°C	± 1.5°C
	191°C to 1200°C	0.11°C	± 0.500°C	± 1°C
E – Thermocouple	– 270°C to – 260°C	1.00°C	± 3°C	± 6°C
	– 260°C to – 225°C	0.25°C	± 1°C	± 2°C
	– 225°C to – 200°C	0.08°C	± 0.750°C	± 1.5°C
	– 200°C to 1000°C	0.09°C	± 0.500°C	± 1°C
K – Thermocouple	– 270°C to – 261°C	2.00°C	± 5°C	± 10°C
	– 260°C to – 246°C	0.56°C	± 2°C	± 4°C
	– 245°C to – 180°C	0.25°C	± 1°C	± 2°C
	– 179°C to – 145°C	0.08°C	± 0.750°C	± 1.5°C
	– 145°C to 1372°C	0.14°C	± 0.500°C	± 1°C
T – Thermocouple	– 270°C to – 261°C	1.50°C	± 4°C	± 8°C
	– 260°C to – 251°C	0.38°C	± 2°C	± 4°C
	– 250°C to – 181°C	0.18°C	± 1°C	± 2°C
	– 180°C to – 136°C	0.08°C	± 0.750°C	± 1.5°C
	– 135°C to 400°C	0.06°C	± 0.500°C	± 1°C
± 10mV	–± 10mV	–± 1.2µV	± 0.25%	± 0.05%

Note: The CJC RTD adds an additional error (see *Table 3-35*)

Table 3-35. LLAI Module RTD Error with CJC at 25°C

Thermocouple Type	Process Temperature Range	RTD Error with CJC @ 25°C
B	100°C to 1820°C	± 0.30°C
R	– 50°C to +50°C	± 0.49°C
	+50°C to 1720°C	± 0.30°C
S	– 50°C to +50°C	± 0.45°C
	+50°C to 1760°C	± 0.30°C
C	0°C to 2315°C	± 0.30°C
N	– 270°C to – 261°C	± 20.50°C
	– 260°C to – 251°C	± 5.00°C
	– 250°C to – 231°C	± 2.70°C
	– 230°C to – 189°C	± 1.40°C
	– 188°C to – 70°C	± 0.70°C
	– 70°C to + 25°C	± 0.35°C
	+25°C to 1300°C	± 0.30°C
J	– 210°C to – 111°C	± 0.80°C
	– 110°C to +25°C	± 0.40°C
	+25°C to 1200°C	± 0.30°C

Thermocouple Type	Process Temperature Range	RTD Error with CJC @ 25°C
E	– 270°C to – 261°C	± 10°C
	– 260°C to – 245°C	± 3°C
	– 244°C to – 200°C	± 1.50°C
	– 200°C to – 87°C	± 0.75°C
	– 86°C to +25°C	± 0.39°C
	+25°C to 100°C	± 0.30°C
K	– 270°C to – 261°C	± 15.00°C
	– 260°C to – 247°C	± 4.50°C
	– 246°C to – 222°C	± 2.20°C
	– 220°C to – 160°C	± 1.10°C
	– 159°C to +25°C	± 0.55°C
	+25°C to 1372°C	± 0.30°C
T	– 270°C to – 261°C	± 10.30°C
	– 260°C to – 243°C	± 3.00°C
	– 242°C to – 196°C	± 1.50°C
	– 195°C to – 61°C	± 0.75°C
	– 60°C to +25°C	± 0.375°C
	+25°C to 400°C	± 0.30°C

Note: Use straight-line approximation to calculate approximate error between end points.

Software Configuration

To use data from an Isolated Low Level Analog Input module you must add a **CWM_TC6** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

3.16 Non-isolated HART®/BTI Interface Module

Non-isolated Highway Addressable Remote Transducer (HART)/Bristol Transmitters (BT) Interface modules provide eight channels individually configurable for HART, BTI, or 4–20 mA inputs. Additionally, you can configure two of the eight channels for 4–20 mA outputs.

There are several ways you can use the individual channels on the module:

- **Point-to-Point BSAP communication with a Bristol Transmitter**
  In this mode, the specified input channel receives data from a single Bristol 3508 or 3808 transmitter using the BSAP communication protocol. In the I/O Configurator within ControlWave Designer software, you must configure the channel as **BTI** and you access individual variables from the transmitter through either the LBTI function block or the XMTR function block. With 1200 baud communications to the transmitter, module data refreshes every second. Additionally, you can separately monitor the primary variable (usually pressure or temperature) at rates up to once every 100 milliseconds. To do this, use a ControlWave variable to access the 4-20 mA current loop by assigning it directly in software to the I/O pin for the channel.

- **Point-to-Point HART communication with a HART Transmitter**
  In this mode, the specified input channel receives data from a single HART transmitter. In the I/O Configurator within ControlWave Designer software, you must configure the channel as **Analog Input** and you access individual variables from the transmitter through the HART function block. With 1200 baud communications to the transmitter, module data refreshes every second, unless a secondary master (such as a hand-held device) is communicating on the loop. Additionally, you can separately monitor the primary variable (usually pressure or temperature) at rates up to once every 100 milliseconds. To do this, use a ControlWave variable to access the 4-20 mA current loop by assigning it directly in software to the I/O pin for the channel.

- **Point-to-Point HART output communication with single HART digital valve controller, or other HART device that is not a transmitter (Channel 1 or 2 ONLY)**
  In this mode, you configure either channel 1 or 2 as an output. In the I/O Configurator within ControlWave Designer software, you must configure the channel as **Analog Output** and you access individual variables from the HART device through the HART function block. With 1200 baud communications to the transmitter, module data

refreshes every second, unless a secondary master (such as a hand-held device) is communicating on the loop.

- **Multi-drop HART communication with up to five HART Transmitters**

  In this mode, you can communicate with up to five HART transmitters multi-dropped to the specified input channel. In the I/O Configurator within ControlWave Designer software, you must configure the channel as **HART Multidrop** and you access individual variables from each transmitter through its own *dedicated* HART function block – one separate function block for each transmitter on the channel. With 1200 baud communications to the transmitter, module data refreshes once every second per transmitter on the channel, unless a secondary master (such as a hand-held device) is communicating on the loop. For example, if there are three multi-dropped transmitters on the channel, data updates to/from a transmitter occur once every three seconds. Similarly, with five multi-dropped transmitters, data updates to/from a transmitter occur once every five seconds. To ensure proper communication between the transmitter and its corresponding function block, you must configure each HART function block with the unique tag name for the transmitter it references.

Notes:

- For detailed information on HART communications including configuration and wiring, visit the HART Communication Foundation website at: http://www.hartcomm2.org.
- The HART/BTI module does not support Burst mode. Do not attempt to configure a HART device in burst mode. If a HART device is in burst mode, use a hand-held communicator to turn off burst mode.
- A ControlWave Micro / EFM equipped with this module is considered to be a HART host (primary master) interface with a Class 1 conformance classification, and supports most Universal and some Common Practice commands. The supported commands conform to *HART Universal Command Specification Revision 5.1 and Common Practice Command Specification Revision 7, (HCF SPEC 127 & 151).*
- For detailed information on configuring function blocks, see the online help in ControlWave Designer.
- You can install this module in any available I/O slot within the ControlWave Micro or ControlWave EFM (up to a maximum of two HART/BTI modules).
- The HART/BTI module is **not** compatible with the ControlWave Micro I/O expansion rack.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

Configuration

The non-isolated HART/BTI module (general part number **396983-XX-X**) has the following configurations:

Table 3-36. Non-Isolated HART/BTI Interface Module

Part Number	Termination Connector	Notes
396983-01-4	local	
396983-02-2	remote	

Wiring the Module

The HART/BTI module includes eight 4-20 mA input channels, two of which you can optionally re-configure as 4-20 mA output channels. All eight channels are individually selectable for either HART, Bristol transmitter, or 4-20 mA analog input operation. The first four channels are on the main board; the second four channels are on the daughter board.

You connect the module and the device (either HART, 3508, or 3808) using two-wire current-sourced twisted pair copper wire.

Refer to the figures and tables that follow for wiring configurations to the board.

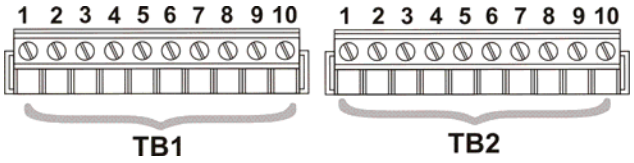


Figure 3-31. TB1 and TB2 Terminal Blocks

Table 3-37. HART/BTI Wiring Connections – Local Termination

TB1 Wiring Connections		TB2 Wiring Connections	
1	CHANNEL 1	1	CHANNEL 5
2	ISOGND	2	ISOGND
3	CHANNEL 2	3	CHANNEL 6
4	ISOGND	4	ISOGND
5	CHANNEL 3	5	CHANNEL 7
6	ISOGND	6	ISOGND
7	CHANNEL 4	7	CHANNEL 8
8	ISOGND	8	ISOGND

TB1 Wiring Connections		TB2 Wiring Connections	
9	+24V	9	+24V
10	24VRET	10	24VRET

If using remote terminations, see *Figure 3-32*.

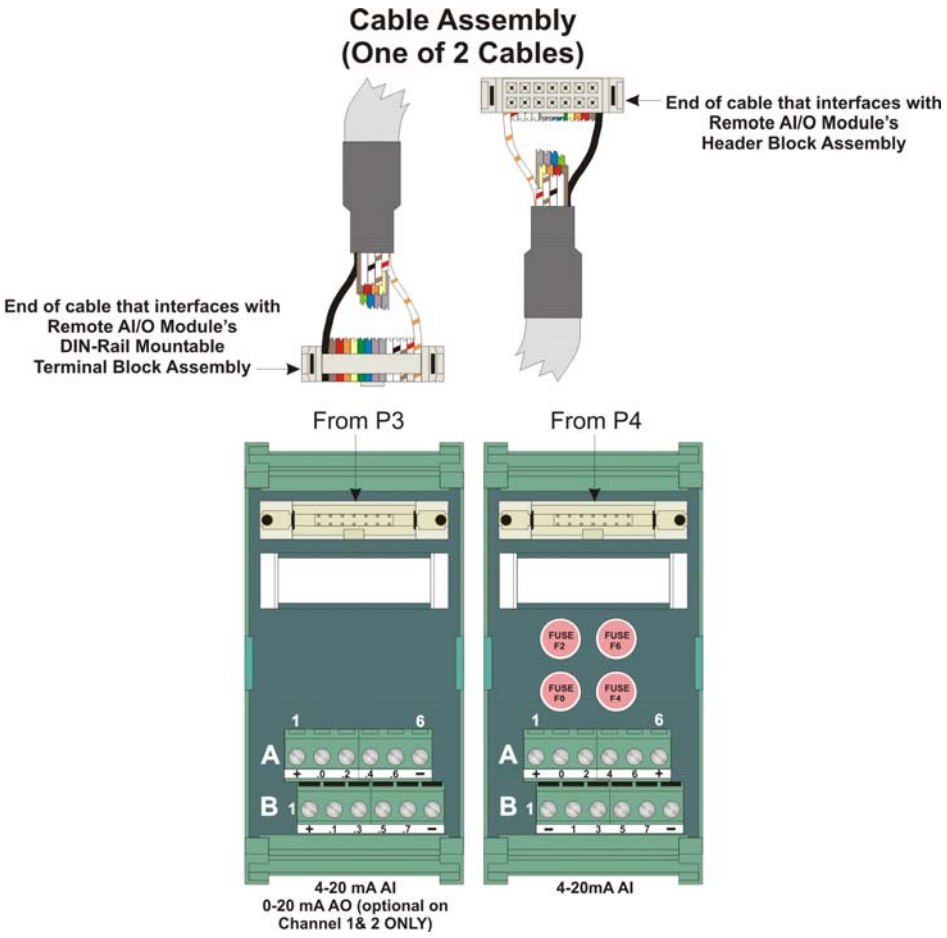


Figure 3-32. HART/BTI Terminal Blocks for Remote Termination (shown with and without fuses)

Table 3-38. HART/BTI Connections for Remote Termination

A = Top terminal block		A = Top terminal block	
+	= 24V	+	= 24V
.0	= CHANNEL 1	0	= CHANNEL 5
.2	= CHANNEL 2	2	= CHANNEL 6
.4	= CHANNEL 3	4	= CHANNEL 7
.6	= CHANNEL 4	6	= CHANNEL 8
-	= 24V RET	+	= 24V
B = Bottom terminal block		**B = Bottom terminal block**	
+	= 24V	-	= 24V RET

.1 = ISOGND	1 = ISOGND
.3 = ISOGND	3 = ISOGND
.5 = ISOGND	5 = ISOGND
.7 = ISOGND	7 = ISOGND
- = 24V RET	- = 24V RET
	Fuses: F0, F2, F4, F6: 1/8 A

The transmitter (XMTR) may be a HART device, a Bristol 3508 transmitter, or a Bristol 3808 transmitter. HART devices may be multi-dropped, up to five devices on a channel, allowing up to 40 HART devices if all eight channels are used. The Bristol transmitters may **not** be multi-dropped.

You wire the transmitters differently depending upon whether the transmitters are multi-dropped, and whether power for the transmitters is externally or internally sourced.

Internally Sourced Transmitters

Connect the positive terminal of each transmitter to the +24V terminal (#9 on the board's terminal block) as shown in *Figure 3-33*.

Connect the negative terminal of each transmitter to the appropriate channel terminal on the board's terminal block. (Also see *Table 3-37* and *Table 3-38* to identify channel terminals).

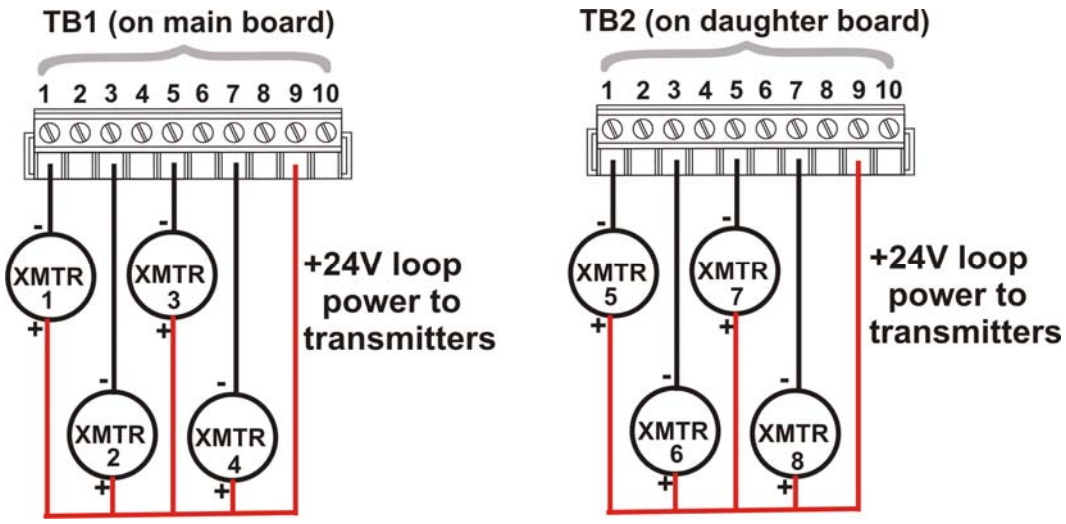


Figure 3-33. Example of Wiring Transmitters (1 per channel) – Internally Sourced

Externally Sourced Transmitters

An external 24V power source is required for applications with more than eight transmitters.

Connect the positive terminal of each transmitter to the +24V external source (see *Figure 3-34*).

Connect the negative terminal of each of up to five HART multi-dropped transmitters (or a single Bristol transmitter) to the appropriate channel terminal on the board's terminal block. (Also see *Table 3-37* and *Table 3-38* to identify channel terminals).

Connect the ISOGND terminals of TB1 and TB2 to the negative terminal of the +24V external source.

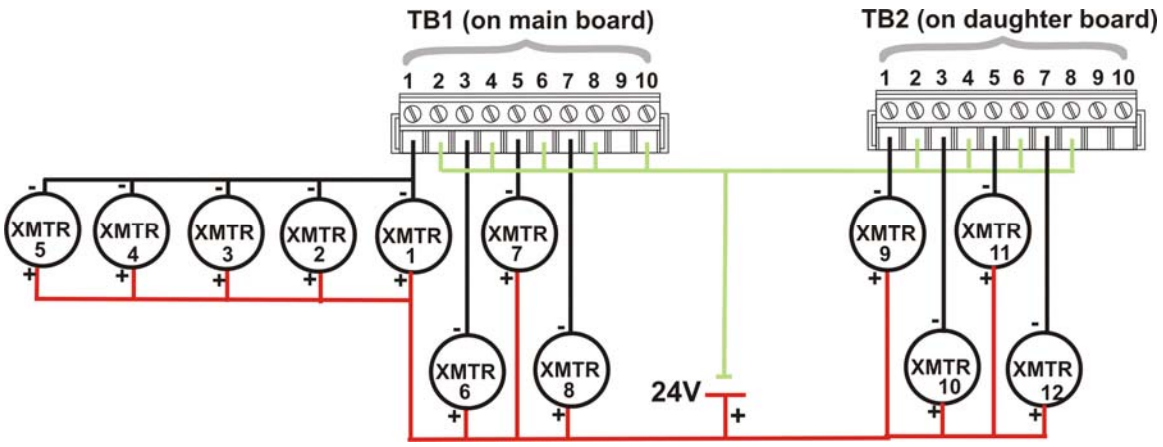


Figure 3-34. Example of Wiring Transmitters using Multi-dropped HART transmitters on Channel 1 – Externally Sourced

Setting Switches

Switches SW3 and SW4 are associated with Channels 1 and 2, respectively. By default, all channels are inputs, however, when either or both Channel 1 and 2 are used with a non-multi-dropped HART device, you can optionally use them as either analog inputs or, if the HART device is not a transmitter, analog outputs.

For a Bristol transmitter (3508/3808) or a multi-dropped HART device, all channels must be inputs.

Set the switches according to *Table 3-38*, below.

Note: Switches not mentioned here are for factory use only and should not be touched.

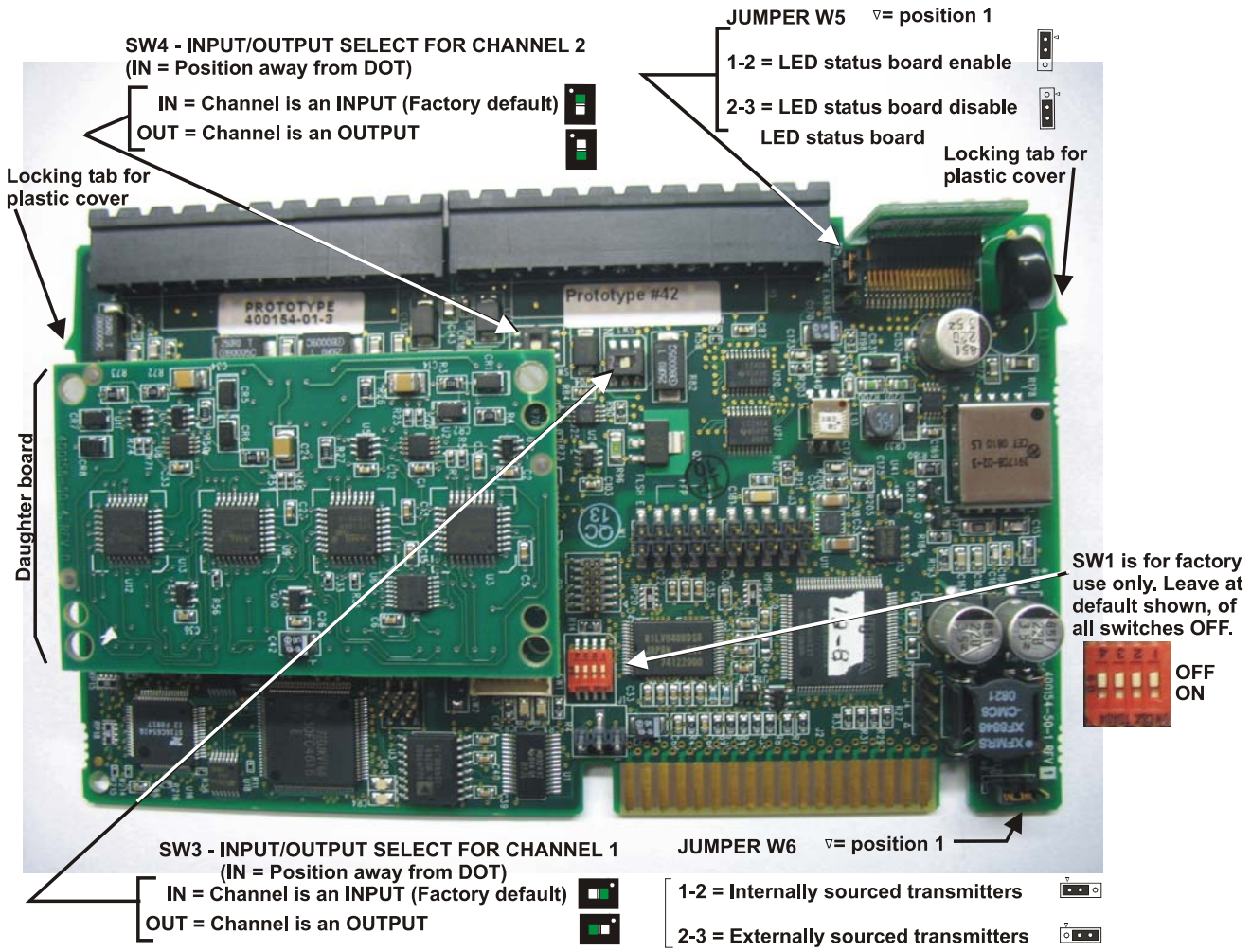

JUMPER W5 ▽= position 1
1-2 = LED status board enable
2-3 = LED status board disable
LED status board
SW4 - INPUT/OUTPUT SELECT FOR CHANNEL 2
(IN = Position away from DOT)
IN = Channel is an INPUT (Factory default)
OUT = Channel is an OUTPUT
Locking tab for plastic cover
Locking tab for plastic cover
PROTOTYPE 400154-01-3
Prototype #42
Daughter board
SW1 is for factory use only. Leave at default shown, of all switches OFF.
OFF
ON
SW3 - INPUT/OUTPUT SELECT FOR CHANNEL 1
(IN = Position away from DOT)
IN = Channel is an INPUT (Factory default)
OUT = Channel is an OUTPUT
JUMPER W6 ▽= position 1
1-2 = Internally sourced transmitters
2-3 = Externally sourced transmitters

Figure 3-35. Switches and Jumpers on the HART/BTI Interface Module

Caution **Settings for SW3 and SW4 must be consistent with the I/O configuration of the corresponding channels in ControlWave Designer. To find the location of the switches on the board, see *Figure 3-35.***

Table 3-39. HART/BTI Switch Settings for SW3 and SW4 (for Non multi-dropped HART devices only)

Switch Number	Setting (BOLD =Factory default) IN=position away from the dot on the switch	
SW3	**IN**	Channel 1 is an analog input.
	OUT	Channel 1 is an analog output.
SW4	**IN**	Channel 2 is an analog input.
	OUT	Channel 2 is an analog output.

Setting Jumpers To locate jumpers, see *Figure 3-35.*

Set jumpers according to the *Table 3-40*, below:

Note: Jumpers not mentioned here are for factory use only and should not be touched.

Table 3-40. HART/BTI User-configurable Jumpers

Jumper	Description
W5	**RX, TX LED Enable** Position 1 to 2: LEDs enabled Position 2 to 3: LEDs disabled Normally, you would enable the LEDs, unless power is a consideration, in which case you could disable them to save power.
W6	**Transmitter Power Source** Position 1 to 2: The HART/BTI module supplies the power to drive the loop current for the HART or Bristol device. (Internally Sourced) Position 2 to 3: The HART/BTI module does **not** supply power to drive the loop current. The HART or Bristol 3508/3808 devices must be powered from an external power source. (Externally Sourced)

Software Configuration

To use data from a HART/BTI module you must add a **CWM_HIB** board in ControlWave Designer's I/O Configurator, and then configure it. See the *ControlWave Designer Programmer's Handbook* (D5125) for more information. That same manual includes an *I/O Mapping* section that describes, for advanced users, the I/O map for this module.

- **HART devices:**

  Configure a HART function block. See the ControlWave Designer online help for details.

- **Bristol 3508 or 3808 transmitters:**

  Configure either an LBTI function block or a XMTR function block. The LBTI function block allows you to read the value of process values from the transmitter, and also to control the output of the transmitter's 4-20 mA current loop. The XMTR function block is for advanced users who want to read/write directly to memory of the transmitter, and perform more detailed configuration. See the ControlWave Designer online help for details on these function blocks.

3.17 IEC62591 Interface Module

The IEC62591 interface module allows your ControlWave Micro to communicate to a network of IEC62591WirelessHART™ field devices such as transmitters. Once you install the module and configure the associated ControlWave project using ControlWave Designer (available in OpenEnterprise™ Field Tools), you connect it to a Smart Wireless Field Link so it can access the wireless network.

The IEC62591 interface module assembly consists of two printed circuit boards; a carrier board that fits into an I/O slot in the ControlWave backplane, and an interface board that sits on the carrier board.

When configured and activated, the system performs an auto-discovery of wireless devices in the network, and then collects data from them into structures within your ControlWave project.

Notes:

- Your controller can only have one (1) IEC62591 interface module.
- Due to mechanical restrictions, you cannot install the IEC 62591 module in the last slot of any housing.
- The IEC62591 interface module is **not** compatible with the ControlWave Micro I/O expansion rack.
- Each field device that will be part of the wireless network must be individually configured with a unique long tag name, and a common network ID and common join key used for the network. Use either the HART Device Configurator tool in OpenEnterprise™ Field Tools software or use an Emerson 375/475 hand-held Field Communicator to perform this configuration. For information on Field Tools software, see the *OpenEnterprise™ Field Tools Installation and Licensing Manual* (D5141).
- The module is factory-configured for optimal performance. No changes to DIP switches are required.

Detailed Technical Specifications

For detailed technical specifications, please see our website http://www.emersonprocess.com/remote.

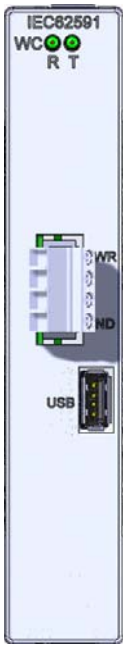


Figure 3-36. IEC62591 Interface Module

Connection

You can install the IEC62591 interface module assembly in an open I/O slot in the ControlWave Micro except, due to a mechanical restriction, it cannot reside in the last slot of any housing.

You must connect an RS-485 cable between the RS-485 port on the module, and the Smart Wireless Field Link. This requires a Belden 2-twisted pair cable.*Table 3-41* shows connections for the twisted pair cable. You must also connect termination jumper wires as shown in *Figure 2-38*.

Table 3-41. RS-485 Cable Connections

Smart Wireless Field Link	IEC62591 Module
A(+)	A
B(-)	B
POWER -	GND
POWER +	PWR

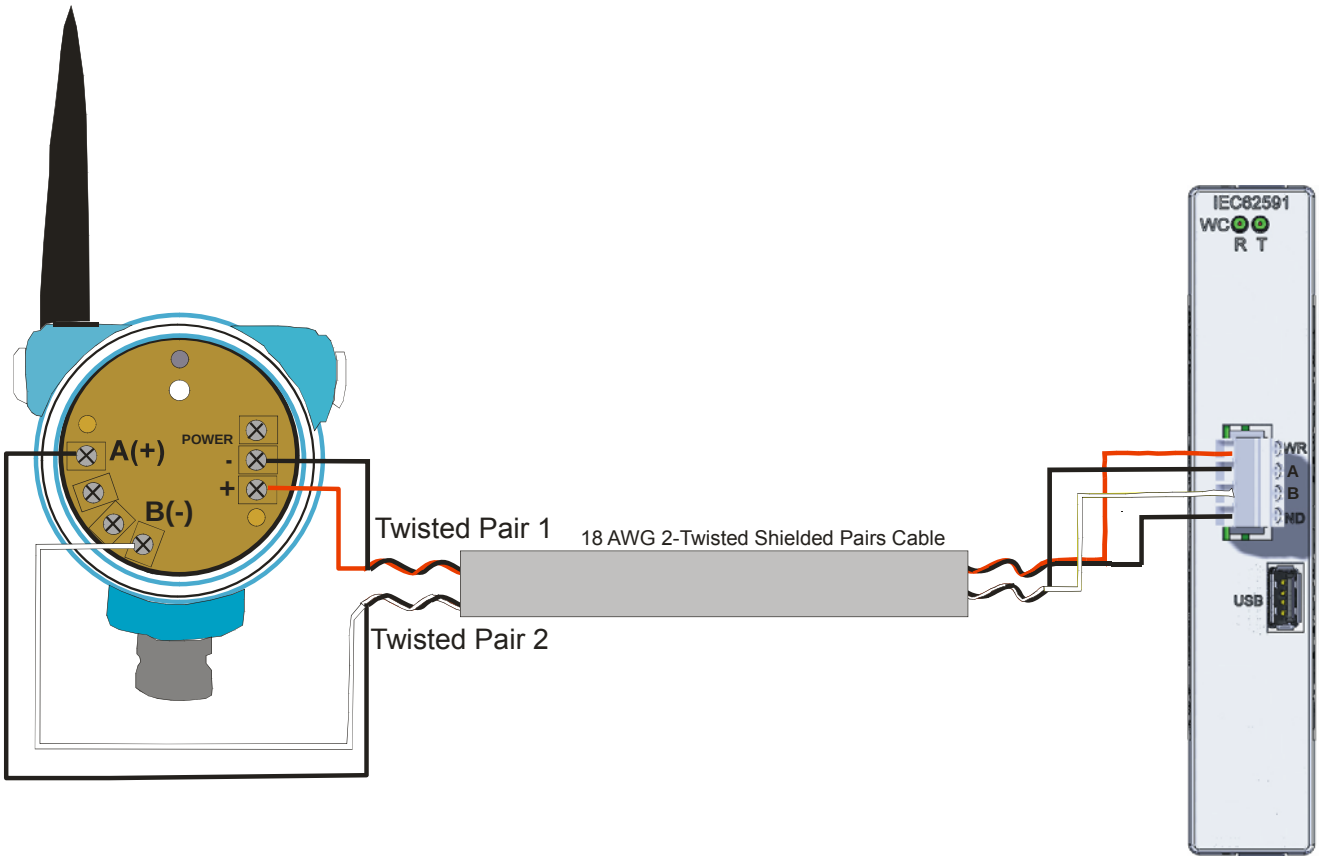


Figure 3-37. Smart Wireless Field Link Connection to IEC62591 Interface Module

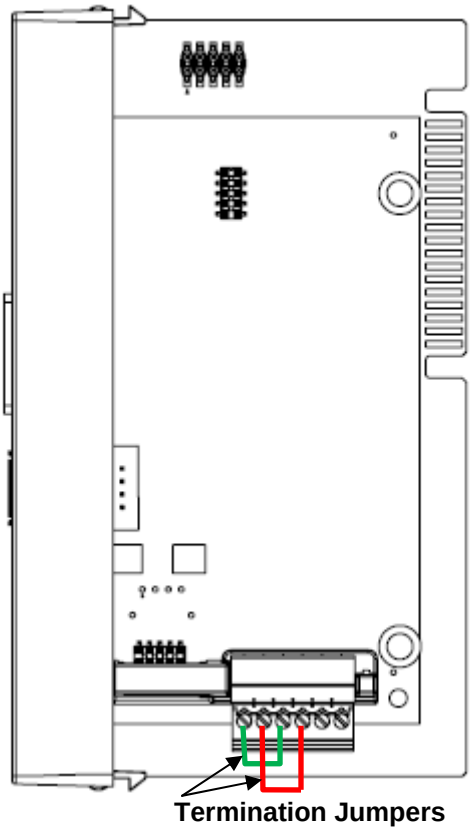


Figure 2-38. IEC62591 Module – Connecting Termination Jumpers

Software Configuration

After you configure a wireless network for your devices, you need to configure your ControlWave project to access the interface module, and through it, the wireless network.

To do this, you either need to modify the IEC62591 example program in ControlWave Designer to meet the needs of your application, or you need to copy all the POUs, structures and variables associated with the example program into an existing project.

In your ControlWave project you must specify the network ID and join key for the network, which are parameters to the IEC62591 function block. You also need to specify the long tag name associated with each wireless device and set its flag for commissioning. In addition you must specify structure sizes based on the maximum number of wireless devices to include in your network.

See *Chapter 3* of the *ControlWave IEC62591 Wireless Interface Instruction Manual* for information on modifying the IEC62591 example program.

For detailed information on configuring the IEC62591 function block, which is used in the example program, refer to the online help within ControlWave Designer.

Chapter 4 – Operation

This chapter provides general operational details for using the ControlWave Micro.

In This Chapter

4.1 Powering Up/Powering Down the ControlWave Micro 4-1
4.2 Setting Operating Mode (Run/Remote/Local or Mode Switch) 4-2
4.3 Communicating with the ControlWave Micro 4-3
4.3.1 Default Comm Port Settings 4-3
4.3.2 Changing Port Settings 4-4
4.3.3 Collecting Data from the ControlWave Micro 4-5
4.4 Creating and Downloading an Application (ControlWave Project) 4-5
4.5 Creating and Maintaining Backups 4-6
4.5.1 Creating a Zipped Project File (*.ZWT) For Backup 4-7
4.5.2 Saving Flash Configuration Parameters (*.FCP) 4-8
4.5.3 Backing up Data 4-9

WARNING

EXPLOSION HAZARD

Substitution of components may impair suitability for use in Class I, Division 2 environments.

When the ControlWave Micro is situated in a hazardous location, turn off power before servicing or replacing the unit and before installing or removing I/O wiring.

Do not disconnect equipment unless the power is switched off or the area is known to be non-hazardous.

4.1 Powering Up/Powering Down the ControlWave Micro

The ControlWave Micro receives power from an external bulk power supply into connector TB1. *Chapter 2* includes instructions for wiring a power supply to the ControlWave Micro.

To apply power to the ControlWave Micro, plug the power supply into connector TB1 on the PSSM.

To remove power from the ControlWave Micro, unplug the power supply from connector TB1 on the PSSM.

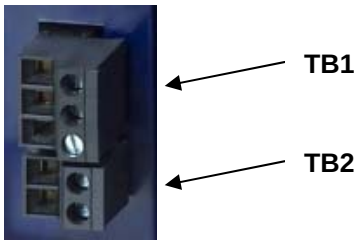


Figure 4-1. Connectors TB1 and TB2

4.2 Setting the Operating Mode (Run/Remote/Local Switch or Mode Switch)

The PSSM you receive has either a key-operated Run/Remote/Local switch (see *Figure 2-9*) or a Mode switch (see *Figure 2-10*).

Run/Remote/ Local Switch

You set the PSSM's Run/Remote/Local switch using a removable key. You can remove this key when the switch is in any position to prevent an unauthorized person from changing the operating mode.

Figure 4-2. Run/Remote/Local Key Switch

Run prevents you from performing any ControlWave Designer debug or program functions (start/stop, application downloads, etc.). **Remote** and **Local** functions depend on how you configured the communication port in ControlWave Designer (serial, IP, or OpenBSI).

- **IP/OpenBSI (BSAP)**: If you configure the communication port for either of these choices in ControlWave Designer it becomes a remote port: set the Run/Remote/Local switch to **Remote** for downloads.
- **Serial**: If you configure the communication port for serial in ControlWave Designer, it becomes a local port: set the Run/Remote/Local switch to **Local** for downloads.

> **Note**: Setting the Run/Remote/Local switch to **Local** enables communications through any comm port. However, if you set the switch to **Remote**, that restricts communications **only** to comm ports configured as remote comm ports.

Mode Switch

Instead of a Run/Remote/Local switch, some versions of the ControlWave Micro include a mode switch (SW1). This is a two-position piano type DIP switch that allows you to configure the mode for firmware upgrades, core updumps, or normal running operations (see *Figure 4-3*).

- Set both DIP switches to either the Open position (to the right) or the Closed position (to the left) to place the ControlWave Micro in **Recovery** mode. Use Recovery mode for a firmware upgrade or a core updump (see *Chapter 5*). Set SW1-1 (the upper DIP switch) to the Open (right) position and SW1-2 (the lower DIP switch) to the Closed (left) position to place the ControlWave Micro in **Local** mode, which is used for normal running operations.

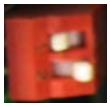


Figure 4-3. Mode Switch

4.3 Communicating with the ControlWave Micro

You communicate to the ControlWave Micro by connecting a cable between a port on your PC workstation and one of the ControlWave Micro ports.

The port at the PC workstation must match the configuration of the ControlWave Micro port.

4.3.1 Default Comm Port Settings

As delivered from the factory, ControlWave Micro communication ports have default settings. *Table 4-1* details these defaults.

Table 4-1. Default Comm Port Settings (by PCB)

Port	PCB	Default Configuration
COM1	CPU	Ships from factory at RS-232; 115.2 Kbps using BSAP. Once the default switch is OFF, a factory default of IP Point-to-Point protocol (PPP) at 115,200 applies.
COM2	CPU	RS-232; 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol
COM3	CPU	RS-485; 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol
COM4	ECOM Type 1 or Type 2	RS-232; 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol
COM5	ECOM Type 1	RS-485; 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol
	ECOM Type 2	RS-232; 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol
COM6	ECOM Type 1	Not applicable
	ECOM Type 2	RS-485; 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol
COM7	ECOM Type 1	Not applicable
	ECOM Type 2	RS-485; 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol
COM8	ECOM Type 1 or Type 2	RS-232; 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol
COM9	ECOM Type 1	RS-485; 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol
	ECOM Type 2	RS-232; 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol
COM10	ECOM Type 1	Radio port

Port	PCB	Default Configuration
	ECOM Type 2	RS-485; 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol
COM11	ECOM Type 1	Modem port
	ECOM Type 2	RS-485; 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol

Notes:

- You can re-enable the factory default comm. settings at any time by setting switch SW2-3 on the CPU module to "OFF."
- If you set both SW2-3 and SW2-8 to "OFF" all serial ports (including COM1) become 9600 baud/BSAP. This is used for diagnostics mode.
- For information on communication cables see *Chapter2*.

Ethernet

Using an optional Ethernet port (located on the CPU module), you can connect either directly or through a network to a PC equipped with an Ethernet port.

Your ControlWave Micro may include 0, 1, or 2 Ethernet ports, depending upon the type of CPU module. If Ethernet port(s) are present, the factory pre-configures initial IP addresses and masks, as follows:

ETH1 IP Address: 10.0.1.1 IP Mask: 255.255.255.0

ETH2 IP Address: 10.0.2.1 IP Mask: 255.255.255.0

Because each unit that ships from the factory has these addresses initially pre-programmed, you should only use these addresses for "bench" testing and configuration. You must change these addresses before putting ControlWave units on an actual network, since an address conflict would exist as soon as you place the second ControlWave unit online.

4.3.2 Changing Port Settings

You change port settings (baud rate, port type, IP address, and so on) using the Flash Configuration utility.

You must establish communications with the ControlWave Micro using NetView, LocalView, or TechView before you can run the Flash Configuration utility.

Note: For detailed information on using the Flash Configuration utility, see *Chapter 5* of the *OpenBSI Utilities Manual* (D5081).

Caution **When you change the baud rate for a port, the baud rate changes as soon as you write the flash file changes to the RTU, and do not require**

a reset. For this reason, you should not change baud rate for the active port on which you are communicating, or communications will immediately stop due to the baud rate mismatch between the PC port and the controller port. If this happens accidentally, you can use CPU switch settings as discussed in the notes in *Section 4.3.1* to restore defaults and re-establish communications.

4.3.3 Collecting Data from the ControlWave Micro

OpenBSI utilities such as DataView, Data Array Save/Restore and Harvester allow you to collect real time data (values of variables, array values, alarm messages) and historical data (audit records, archive files) from the ControlWave. See the *OpenBSI Utilities Manual* (D5081) for details. SCADA software such as OpenEnterprise can then present this data to an operator in the form of graphical displays and reports.

4.4 Creating and Downloading an Application (ControlWave Project)

Your ControlWave Micro executes an application called a ControlWave project. You create the project using PC-based ControlWave Designer software. Instructions for creating a ControlWave project are beyond the scope of this manual. Please refer to the following sources for information:

- *Getting Started with ControlWave Designer* (D5085)
- *ControlWave Micro Quick Setup Guide* (D5124)
- *ControlWave Designer Programmer's Handbook* (D5125)
- ControlWave Designer online help

You must connect the Micro to a PC running ControlWave Designer software and OpenBSI software.

Note: You can download an application either from ControlWave Designer or from the OpenBSI 1131 Downloader.

1. Set the PSSM's Run/Remote/Local (key-operated) switch or Mode switch:

- If the PC is connected to a Micro comm port configured as an **IP or OpenBSI Network port**:
  - Set the PSSM's Run/Remote/Local switch to **Remote**
    or
  - Set the PSSM's Mode Switch (SW1) for Local Mode (that is, SW1-1 to Open [right] and SW1-2 to Closed [left]).
- If the PC is connected to a Micro comm port configured as a **serial port**:
  - Set the PSSM's Run/Remote/Local switch to **Local**
    or

- Set PSSM's Mode Switch (SW1) for Local Mode.

Note: COM1 has a factory default of 115.2 Kps (RS-232) using the Internet Point-to-Point Protocol (PPP). Do not connect COM1 to a PC unless you configure that PC's RS-232 port for PPP.

2. Define the Micro project, setting communication and configuration parameters.
3. Download the project according to instructions in the *Downloading* section of the *ControlWave Designer Programmer's Manual* (D5125).
4. After the download completes successfully, restore the PSSM switch settings:
   - Turn Run/Remote/Local to **Run**
     or
   - Leave Mode switch (SW1) in **Local**.

4.5 Creating and Maintaining Backups

You should always maintain a current backup of each ControlWave project and keep it in a safe place, preferably in a location physically separate from the controller.

The reason we recommend you keep a backup files is that if a disaster occurs that damages or destroys your ControlWave hardware (flood, lightning strike, etc.) you don't want to also lose its control strategy software programs. Otherwise, when the unit is repaired or replaced, you'd have to create a new ControlWave project from scratch, which might take a lot longer than replacing a few damaged modules.

Caution

Always maintain a backup copy of your ControlWave project in a safe place.

Anytime you modify your ControlWave project, be sure to create a new backup of the new project.

Notes:

- You may find it useful to maintain more than one backup copy in case the backup media itself fails, for example, a CD-ROM becomes unreadable because it melted in the sun or a thumb drive fails because someone spilled coffee on it.
- If you don't keep more than one backup copy, it's a good idea to periodically test your backup copy to verify that the media has not failed.

4.5.1 Creating a Zipped Project File (*.ZWT) For Backup

Note: The .zwt file is a complete backup of your entire project including code, comments and graphics. It may be stored on your PC or removable storage media. It may also be downloaded and archived to ControlWave Flash memory where it may be uploaded at a later time for editing.

With your current ControlWave project open in ControlWave Designer, perform the following steps:

1. Click **File > Save Project As / Zip Project As.**

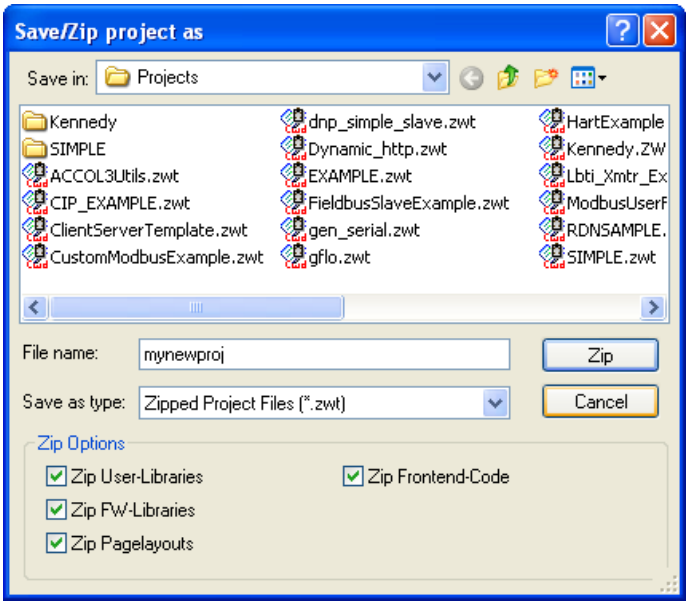


Figure 4-4. Saving a Backup of Your Project

2. In the "Save/Zip project as" dialog box, specify a project name in the **File name** field. In *Figure 4-4* we chose the name **mynewproj**.
3. In the **Save as type** field, choose **Zipped Project Files (*.zwt)**.
4. In the **Zip Options** area, select which additional files you want to include in the zwt file. Other than increasing the file size of the zwt, it doesn't hurt to check any or all of these options.

Zip Option	Description
Zip User-Libraries	If you created your own user-defined functions or function blocks, you must select this to preserve them.
Zip Frontend-Code	If you selected **Zip User-Libraries** you should also select this option to include compiled code for libraries in your zip file. Otherwise, you need to re-compile your user libraries with the project when you unzip the zwt.

Zip Option	Description
Zip FW-Libraries	This includes firmware libraries, such as ACCOL3.FWL in your zwt.
Zip Pagelayouts	This includes pagelayout information for printing your project, as well as graphical elements used in certain 1131 languages.

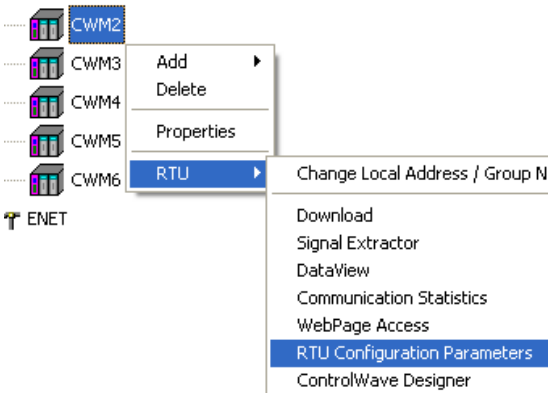
5. Click **Zip** and a progress bar displays the percent complete of the zipping process.
6. When the zip process completes, you'll see a message box reporting successful completion. Click **OK**.
7. Copy the resulting zwt file to backup media (CD-ROM, thumb drive, etc.) If you ever need to restore the project, just open the zwt file in ControlWave Designer, load libraries as needed, then compile the project and download it into the ControlWave.

4.5.2 Saving Flash Configuration Parameters (*.FCP)

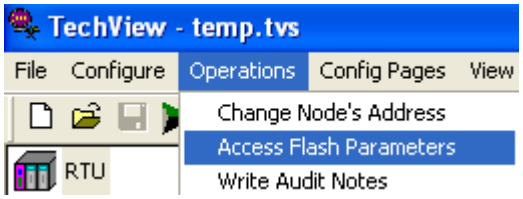
You must establish communications with the ControlWave Micro using NetView, LocalView, or TechView before you can run the Flash Configuration utility.

Note: For detailed information on using the Flash Configuration utility, see *Chapter 5* of the *OpenBSI Utilities Manual* (D5081).

1. Start the Flash Configuration utility. To do this in NetView or LocalView, *right*-click on the icon for this ControlWave and choose **RTU > RTU Configuration Parameters**.



To do this in TechView, click **Operations > Access Flash Parameters** or click the Access Flash icon .



2. Depending upon how your system is configured, the Flash Configuration – Loading Options dialog box may open. If it does, choose **Load from device** and wait for the utility to retrieve all parameters from the ControlWave, then skip to step 4, otherwise, just proceed to step 3.
3. Click

and wait for the utility to retrieve all parameters from the ControlWave.
4. Click

and specify a name for your FCP file, then click **Save**. When the status line indicates successful completion, your FCP file in done.
5. Copy the resulting FCP file to backup media (CD-ROM, thumb drive, etc.) If you ever need to restore the FCP parameters to the controller, establish communications with the unit, start the Flash Configuration utility, and load the FCP file using the **Read from FCP** button, then choose the **Write to RTU** button.

4.5.3 Backing up Data

You can back up certain types of data and restore it if needed. There are other types of data that you can only collect, but you cannot restore.

- If you have certain variables that represent tuning parameters (setpoints, for example) you can use tools such as the OpenBSI DataView recipe feature to save those values to a recipe file on the PC, and then restore them at a later time. See *Chapter 8* of the *OpenBSI Utilities Manual* (D5081).
- You can store the contents of read/write data arrays using the OpenBSI Data Array Save/Restore utility. See *Chapter 13* of the *OpenBSI Utilities Manual* (D5081).
- You can collect alarms, and historical data (audit records, archive files) but you cannot restore alarms or historical data.

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Chapter 5 – Service and Troubleshooting

This chapter provides general diagnostic and test information for the ControlWave Micro.

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Equipment

You need the following equipment to perform the procedures described in this chapter:

To run diagnostics software:

- PC with WINDIAG software, and either OpenBSI LocalView, NetView, or TechView for communications.
- Null modem interface cable
- Loop-back plug, 9-pin female D-Sub (for RS-232) (see *Figure 5-13*)
- Loop-back plug, 9-pin female D-Sub (for RS-485) (see *Figure 5-14*)
- Loop-back plug, 8-pin RJ-45 male (for twisted pair Ethernet) (see *Figure 5-16*)

To perform firmware upgrades:

- Null modem interface cable
- PC with the following software:
  - o OpenBSI LocalView
  - o OpenBSI System Firmware Downloader and either NetView, LocalView, or TechView for communications.
  - o HyperTerminal (included in Windows®)

To replace the SRAM backup battery:

- Depending on the type of battery holder, either a small flat head screwdriver, or tweezers/needle nose pliers.

To test the Power Supply/Sequencer module (PSSM):

- Digital multi-meter (DMM) with 5-1/2 digit resolution

- DC supply, variable to 30Vdc @ 2.5A (with vernier adjustment)

Note: When you service a ControlWave Micro on site, we recommend that you close down (or place under manual control) any associated processes. This precaution prevents any processes from accidentally running out of control when you conduct tests.

Caution

Harmful electrical potentials may still exist at the field wiring terminals even though the ControlWave Micro's power source may be turned off or disconnected. Do not attempt to unplug termination connectors or perform any wiring operations until you verify that all associated power supply sources are turned off and/or disconnected.

Always turn off any external supply sources for externally powered I.O circuits before you change any modules.

5.1 Upgrading Firmware

The ControlWave Micro CPU ships from the factory with system firmware already installed. If you need to upgrade the system firmware (stored in Flash memory) to acquire new functionality or restore firmware, you can use one of several methods.

System Firmware Downloader

Use this tool to download system firmware to an unattended remote ControlWave Micro. To use this utility, you must set CPU module switch SW2-6 **ON** (the factory default position).

Note: For further information and detailed use instructions, refer to *Appendix J* of the *OpenBSI Utilities Manual* (D5081).

LocalView

One of the standard OpenBSI utilities, LocalView requires OpenBSI version 5.1 (or newer). If you have an older version of OpenBSI, use HyperTerminal.

Note: For further information and detailed use instructions, refer to the Flash Mode section of *Chapter* 5 of the *OpenBSI Utilities Manual* (D5081).

HyperTerminal

HyperTerminal is a communications utility program included with Microsoft® Windows® XP.

Notes:

- If you are using a version of OpenBSI older than 5.1, or do not have OpenBSI software, you can only perform a firmware upgrade using HyperTerminal.
- While HyperTerminal is included in Microsoft® Window® XP, some newer versions of Window® do not include it.

- HyperTerminal requires *.BIN files; newer ControlWave firmware upgrade files use *.CAB files. In cases such as those, you should use the Remote System Firmware Downloader.

1. Connect a null modem cable between COM1 of the ControlWave Micro and any RS-232 port on the associated PC.
2. Click **Start** > **Programs** > **Accessories** > **Communications** > **HyperTerminal**
3. If using HyperTerminal for the first time, set the communication properties (for the PC port) via the Properties Menu as follows: Bits per second: = 115200, Data bits: = 8, Parity: = None, Stop bits: = 1, and Flow control: = None and then click **OK**.
4. Either set the PSSM's Mode Switch (SW1) for Recovery Mode, that is, set both switches in the **OPEN** or **CLOSED** position or set CPU Switch SW1-3 **ON** (ON = Force Recovery).
5. Apply power; to the ControlWave Micro. The resident BIOS initializes and tests the hardware, this process is referred to as POST (Power On Self Test). Unless there is a problem, PSSM status LEDS show status code 10 (LED #5 ON). If you see a different status code, see *Section 5.3.1*
6. From the HyperTerminal Mode menu (*Figure 5-1*), press the **F** key to enter FLASH download. A message warns that the FLASH is about to be erased; press the **Y** key at the prompt. The screen displays dots as the system erases the flash memory; this could take a few minutes.

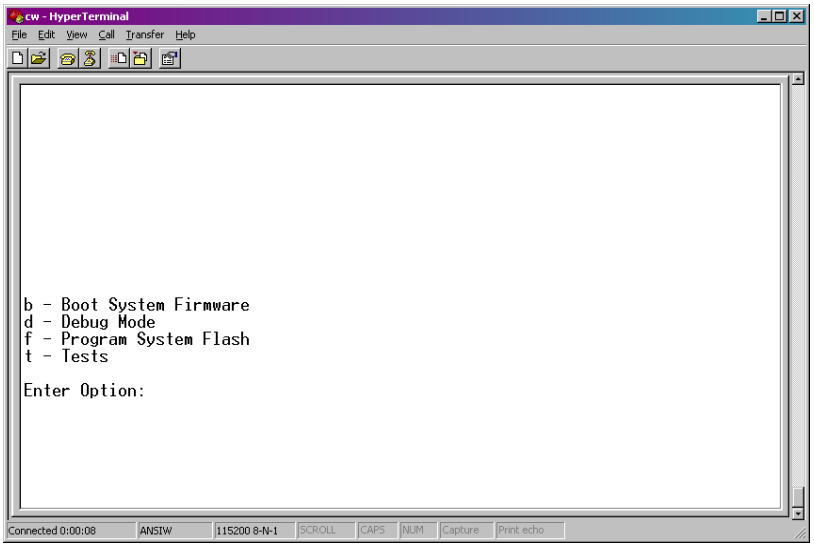
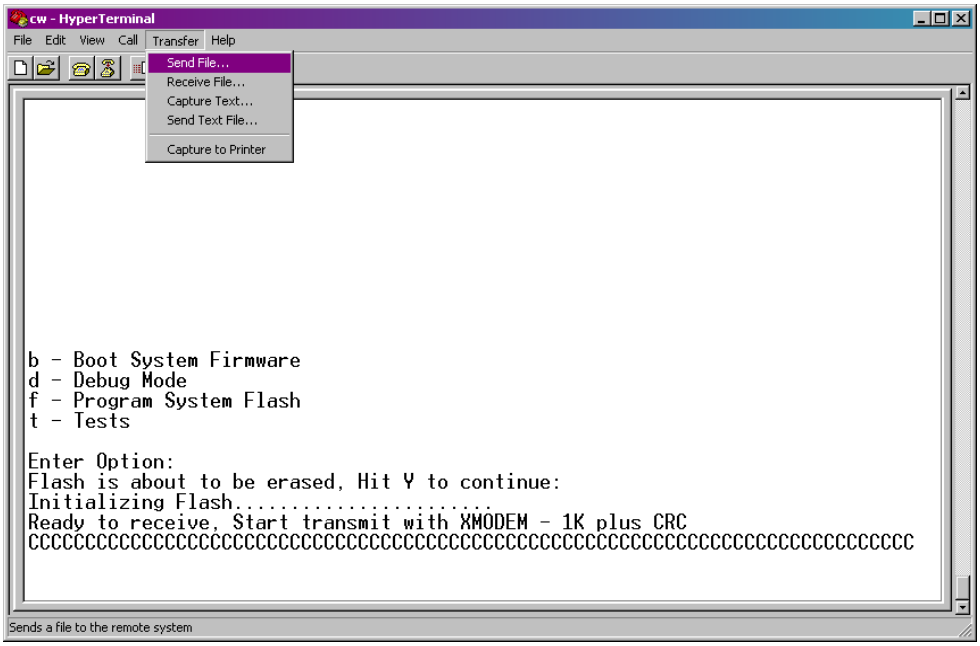


Figure 5-1. HyperTerminal Mode Menu

7. When the FLASH is ready for download, HyperTerminal repeatedly displays the letter C on the screen. In the

HyperTerminal menu bar click **Transfer** > **Send File** (see *Figure 5-2*).


cw - HyperTerminal
File Edit View Call Transfer Help
Send File...
Receive File...
Capture Text...
Send Text File...
Capture to Printer
b - Boot System Firmware
d - Debug Mode
f - Program System Flash
t - Tests
Enter Option:
Flash is about to be erased, Hit Y to continue:
Initializing Flash.....
Ready to receive, Start transmit with XMODEM - 1K plus CRC
CCCC

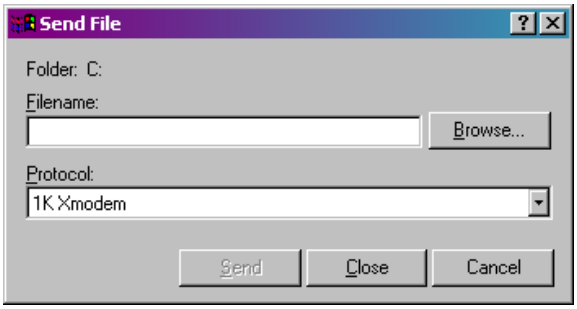


Figure 5-3. Send File dialog box

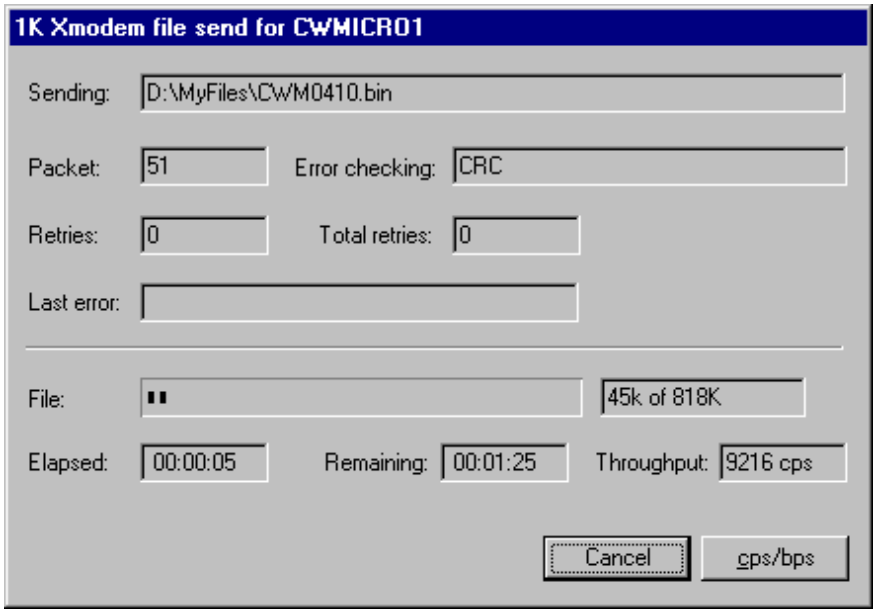


Figure 5-4. HyperTerminal (Download in Process)

5.2 Removing or Replacing Components

This section provides information on accessing Micro modules for testing, as well as removal/replacement procedures.

Caution **Field repairs to ControlWave Micros are strictly limited to the replacement of complete modules. Replacing module components constitutes tampering and violates the product warranty. Return defective modules or housings to the factory for authorized service.**

5.2.1 Accessing Modules for Testing

Only technically qualified personnel should test and/or replace Micro modules. Read completely the disassembly and test procedures described in this manual before starting. Any damage to the ControlWave Micro resulting from improper handling or incorrect

service procedures is not covered under the product warranty agreement. If you cannot properly perform these procedures, obtain authorization and then return the device to the factory for evaluation and repairs.

5.2.2 Removing/Replacing the Bezel

1. Grasp the sides of the bezel assembly and gently lift it up and then off its associated I/O module covers.
2. To replace the bezel, align the latches (left and right, top and bottom) with the associated notches in the I/O module cover. Press the bezel in so that the notches capture its latches and slide it downward until it securely seats.

5.2.3 Removing/Replacing the CPU Module

Use this procedure to remove or replace the CPU module.

1. If the Micro is running, place any critical control processes under manual control.
2. Shut down the Micro by disconnecting the power.
3. Disconnect any CPU module communication cables. Label or otherwise identify them so you can easily return them to their assigned communication ports. .
4. Press down on the cover's built-in top latch (with one hand) and up on the cover's built-in bottom latch (with the other hand).
5. Carefully slide the CPU module out of the front of the housing. If any binding occurs, gently rock the module up and down to free it.
6. To replace a CPU module, power must be off. Carefully align the CPU module with the guides for slot 2 in the Micro and insert the module into the housing. When the module correctly seats, its cover should latch to the housing.
7. Replace any communication cables, apply power, and test the module.

5.2.4 Removing/Replacing the PSSM

Use this procedure to remove or replace the PSSM module.

1. If the Micro is running, place any critical control processes under manual control and shut down the unit by turning off the power.
2. Unplug the PSSM's modular connectors TB1 (Power), TB2 (Watchdog), and J1 Display Interface Connector (if present).

3. Press down on the cover's built-in top latch (with one hand) and up on the cover's built-in bottom latch (with the other hand).
4. Carefully slide the PSSM module out of the front of the housing. If binding occurs, gently rock the module up and down to free it.
5. To replace a PSSM module, power must be off. Carefully align the PSSM module with the guides for slot 1 in the Micro and insert the module into the housing. When the module correctly seats, its cover should latch to the housing.
6. Replace power and watchdog cables (and if provided the Display Interface cable) and then apply power and test the unit.

5.2.5 Removing/Replacing an I/O Module

Use this procedure to remove or replace an I/O module.

1. If the Micro is running, place any critical control processes under manual control and shut down the PSSM module.
2. Remove the applicable bezel (see *Section 5.2.2*).
3. Unplug local termination cable headers from I/O module connectors TB1 and TB2 or remote termination cables headers from connectors P3 and P4 and set the cables aside. Label or otherwise identify these cables so you can easily return them to their assigned connectors.
4. Press down on the cover's built-in top latch (with one hand) and up on the cover's built-in bottom latch (with the other hand).
5. Carefully slide the I/O module out of the front of the housing. If binding occurs, gently rock the I/O module up and down to free it.
6. To replace an I/O module, power must be off. Carefully align the I/O module with the applicable I/O slot and insert the unit into the housing. When the module correctly seats, its cover should latch to the housing.
7. Connect local termination cables to I/O module connectors TB1 and TB2 or remote termination cables to I/O module connectors P3 and P4.
8. Apply power and test the unit.

5.2.6 Removing/Replacing the Backup Battery

Note: The CPU module draws power from the battery only if the module loses power. For a ControlWave Micro containing 2MB of SRAM, a worst-case current draw of 42 uA allows a battery life of approximately 5238 hours. This means you should not

need to replace a battery until the ControlWave Micro has been in service for an extended period (normally many years).

The CPU module accommodates a lithium coin cell backup battery housed in a coin-cell socket (S1). A supervisory circuit on the CPU switches to battery power when the regulated 3.3 Vdc falls out of specification. The battery then provides backup power for the real-time clock (RTC) and the system SRAM on the CPU module.

⚠ Caution

You lose SRAM contents when you remove the backup battery.

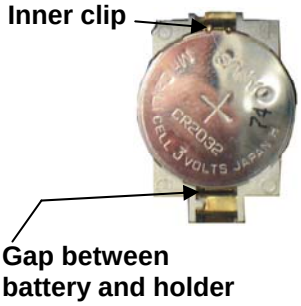
If you replace a backup battery, wait at least one minute before re-powering the system. This enables the SRAM to completely discharge.

After you install the new battery, ensure that you have placed jumper JP8 on pins 1-2 (to enable the battery).

The procedure for replacing the battery varies slightly depending upon the type of battery holder – snap type or clip type.

Removing / Replacing the Battery – Snap Type Holder

Battery Part Numbers:
CR2032
DL2032



1. If the Micro is running, place any critical control processes under manual control.
2. Remove power from the ControlWave Micro.
3. Remove the CPU module from the housing.
4. To remove the lithium battery, insert the tip of a small flat head screw driver into the gap between the battery and the holder. (The gap is on the side of the holder that doesn't have the inner clip against the battery.) Gently push the screwdriver at an angle underneath the battery and it will pop out of the holder.
5. To install the replacement battery, press one side of the battery against the inner clip of the holder then press the battery down into the slot so it snaps in.
6. Replace the CPU module in slot 2 of the housing.
7. Re-connect power to the ControlWave Micro.
8. Once the battery has been replaced, the unit executes its Flash-based application ("boot project") at power-up, but all of the current process data is lost. At power-up, the Micro acts as though it had just been booted and reverts back to the initial values specified in its application.

Removing / Replacing the Battery – Clip Type Holder

Battery Part Numbers:

BR2330, BR2335, BR2335-B

1. If the Micro is running, place any critical control processes under manual control.
2. Remove power from the ControlWave Micro.
3. Remove the CPU module from the housing.
4. To remove the lithium battery, gently pry up the tab holding the battery in the coin cell socket and remove the battery with a pair of tweezers or needle-nosed pliers. Install the replacement battery.
5. Replace the CPU module in slot 2 of the housing.
6. Re-connect power to the ControlWave Micro.
7. Once the battery has been replaced, the unit executes its Flash-based application ("boot project") at power-up, but all of the current process data is lost. At power-up, the Micro acts as though it had just been booted and reverts back to the initial values specified in its application.

5.2.7 Enabling / Disabling the Backup Battery

For maximum shelf life, the CPU module ships from the factory with the installed lithium backup battery disabled. You must enable it when you install the CPU module.

Enabling To enable the battery, install jumper JP8 on pins 1-2.

Disabling For maximum shelf life, you can isolate the battery from the circuit by placing jumper JP8 on pins 2-3.

5.3 General Troubleshooting Procedures

This section presents some procedures to troubleshoot problems with the Micro.

5.3.1 Checking LEDs

Most Micro modules contain light emitting diodes (LEDs) that provide operational and diagnostic functions.

Table 5-1 shows LED assignments on Micro modules.

Table 5-1. LED Assignments on Modules

Module	LED Name	LED Color	Function
PSSM	IDLE	Red	ON = Idle
PSSM	WD	Red	ON = Watchdog condition OFF = Normal

Module	LED Name	LED Color	Function
PSSM	6 STATUS	Red	See *Table 5-2* and *Figure 5-5*
CPU	C1 RX (Comm 1)	Red	ON = RX activity (top left; see *Figure 5-6*)
CPU	C1 TX (Comm 1)	Red	ON = TX activity (top left; see *Figure 5-6*)
CPU	C2 RX (Comm 2)	Red	ON = RX activity (middle left; see *Figure 5-6*)
CPU	C2 TX (Comm 2)	Red	ON = TX activity (middle left; see *Figure 5-6*)
CPU	C3 RX (Comm 3)	Red	ON = RX activity (bottom left; see *Figure 5-6*)
CPU	C3 TX (Comm 3)	Red	ON = TX activity (bottom left; see *Figure 5-6*)
CPU	ENET Port 1	Green	ON = TX activity (J6 bottom; see *Figure 5-6)*
CPU	ENET Port 1	Yellow	ON = RX activity (J6 top; see *Figure 5-6*)
ECOM1	EC 4/8 RX (Comm 4)	Red	ON = RX activity (top left; see *Figure 5-7*)
ECOM1	EC 4/8 TX (Comm 4)	Red	ON = TX activity (top right; see *Figure 5-7*)
ECOM1	EC 5/9 RX (Comm 5)	Red	ON = RX activity (2nd from top left; see *Figure 5-7*)
ECOM1	EC 5/9 TX (Comm 5)	Red	ON = RX activity (2nd from top right; see *Figure 5-7*
ECOM1	Radio RX (Comm6)[1]	Red	ON = RX activity (3rd from top left; see *Figure 5-7*) (Note: Radio no longer offered- ignore - always ON)
ECOM1	Radio TX (Comm6)[1]	Red	ON = TX activity (3rd from top right; see *Figure 5-7*) Note: Radio no longer offered (always OFF)
ECOM1	Modem RX (Comm7)[1]	Red	ON = RX activity (bottom left;; see *Figure 5-7*)
ECOM1	Modem TX (Comm7)[1]	Red	ON = TX activity (bottom right; see *Figure 5-7)*
ECOM2	EC4/8 RX (Comm 4/8) [1]	Red	ON = RX activity (top left; see *Figure 5-8*)
ECOM2	EC4/8 TX (Comm 4/8) [1]	Red	ON = TX activity (top right; see *Figure 5-8*)
ECOM2	EC5/9 RX (Comm 5/9) [1]	Red	ON = RX activity (2nd from top left; see *Figure 5-8*)
ECOM2	EC5/9 TX (Comm 5/9) [1]	Red	ON = TX activity (2nd from top right; see *Figure 5-8*
ECOM2	EC6/10 RX (Comm 6/10) [1]	Red	ON = RX activity (3rd from top left; see *Figure 5-8*)
ECOM2	EC6/10 TX (Comm 6/10) [1]	Red	ON = TX activity (3rd from top right; see *Figure 5-8*)
ECOM2	EC7/11 RX (Comm 7/11) [1]	Red	ON = RX activity (bottom left;; see *Figure 5-8*)
ECOM2	EC7/11 TX (Comm 7/11) [1]	Red	ON = TX activity (bottom right; see *Figure 5-8*)
IDI	INPUT (16 LEDs,1 per point)	Red	LED ON = Input is present LED OFF = Input not present (see *Figure 5-9*)
IDO	OUTPUT (16 LEDs,1 per point)	Red	LED ON = Output is ON (see *Figure 5-9*)
DI/O IDI/O	INPUT (12 LEDs, 1 per point)	Red	LED ON = Input is present LED OFF = Input not present (see *Figure 5-9*)
DI/O IDI/O	OUTPUT (4 LEDs, 1 per point)	Red	LED ON = Output is ON (see *Figure 5-9*)
HSC	INPUT (4 LEDs, 1 per point)	Red	LED ON = Input activity on input is present LED OFF = No activity on input (see *Figure 5-*

Module	LED Name	LED Color	Function
			9)
MI/O	DI INPUT (6 LEDs, 1 per point)	Red	LED ON = Input is present LED OFF = Input not present (see *Figure 5-9*)
MI/O	DI INPUT (6 LEDs, 1 per point)	Red	LED ON = Output is ON (see *Figure 5-9*)
MI/O	HSC INPUT (2 LEDs, 1 per point)	Red	LED ON = Input activity on input is present LED OFF = No activity on input (see *Figure 5-9*)
IDI (Vac)	INPUT (8 LEDs, 1 per point)	Red	LED ON = Input is present LED OFF = Input not present (see *Figure 5-9*)
IDO (Vac/dc)	OUTPUT (8 LEDs, 1 per point)	Red	LED ON = Output is ON (see *Figure 5-9*)

[1]Radio or modem with Type 1 comm board only

PSSM System Status LED Codes

As the Micro runs its application, status codes post to the six LEDs on the PSSM. *Table 5-2* provides activity descriptions of the LEDs; *Figure 5-5* shows what the LEDs look like for each hex code.

Table 5-2. System Status LED Codes on PSSM

Status in Hex	LED 6	ED 5	LED 4	LED 3	LED 2	LED 1	Activity Indicator
00	0	0	0	0	0	0	Application Running
01	0	0	0	0	0	1	Unit in Diagnostic Mode
03	0	0	0	0	1	1	Unit Running Diagnostics
04	0	0	0	1	0	0	Flash XSUM Error
05	0	0	0	1	0	1	Error Initializing Application Device
07	0	0	0	1	1	1	Flash Programming Error
08	0	0	1	0	0	0	Using Factor Defaults (flashed at start)
09	0	0	1	0	0	1	Battery Failure Detected (flashed at startup)
0A	0	0	1	0	1	0	Currently Loading the Boot Project
0B	0	0	1	0	1	1	System Initialization in Progress
10	0	1	0	0	0	0	Waiting in Recovery Mode
11	0	1	0	0	0	1	Error Testing SDRAM
12	0	1	0	0	1	0	Error Testing SRAM
20	1	0	0	0	0	0	Application Loaded
28	1	0	1	0	0	0	Stopped at Break Point
30	1	1	0	0	0	0	No Application Loaded
38	1	1	1	0	0	0	Running with Break Points
3B	1	1	1	0	1	1	Waiting for a Power-down (after NMI)
3E	1	1	1	1	1	0	Waiting for Updump to be Performed
3F	1	1	1	1	1	1	Unit Crashed (Watchdog Disabled)

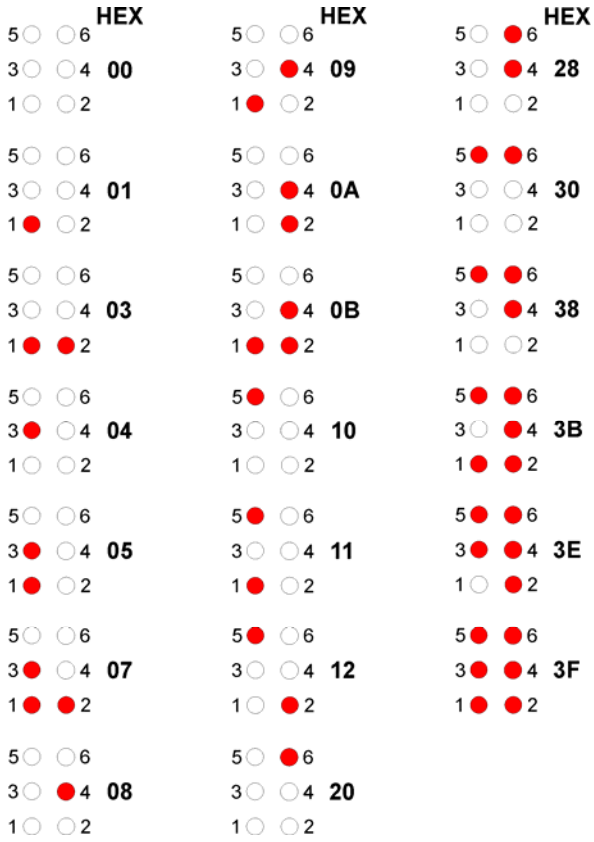


Figure 5-5. PSSM Status LED Hexadecimal Codes

CPU Module LEDs

The CPU module has four or six comm port activity LEDs on the CPU board. Units equipped with an Ethernet port have two additional LEDs located on each Ethernet RJ-45 connector. *Table 5-3* details assignments for the LEDs on the CPU module.

An ON LED indicates an associated transmit (TX) or receive (RX) activity.

Table 5-3. CPU Module LEDs

LED Ref	LED Function
C1	Transmit (TX) COM1
C1	Receive (RX) COM2
C2	Transmit (TX) COM2
C2	Receive (RX) COM2
C3	Transmit (TX) COM3
C3	Receive (RX) COM3
J5 - Bottom	Ethernet Link Transmit (TX)
J5 - Top	Ethernet Link Receive (RX)
J6 – Bottom	Ethernet Link Transmit (TX)
J6 – Top	Ethernet Link Receive (RX)

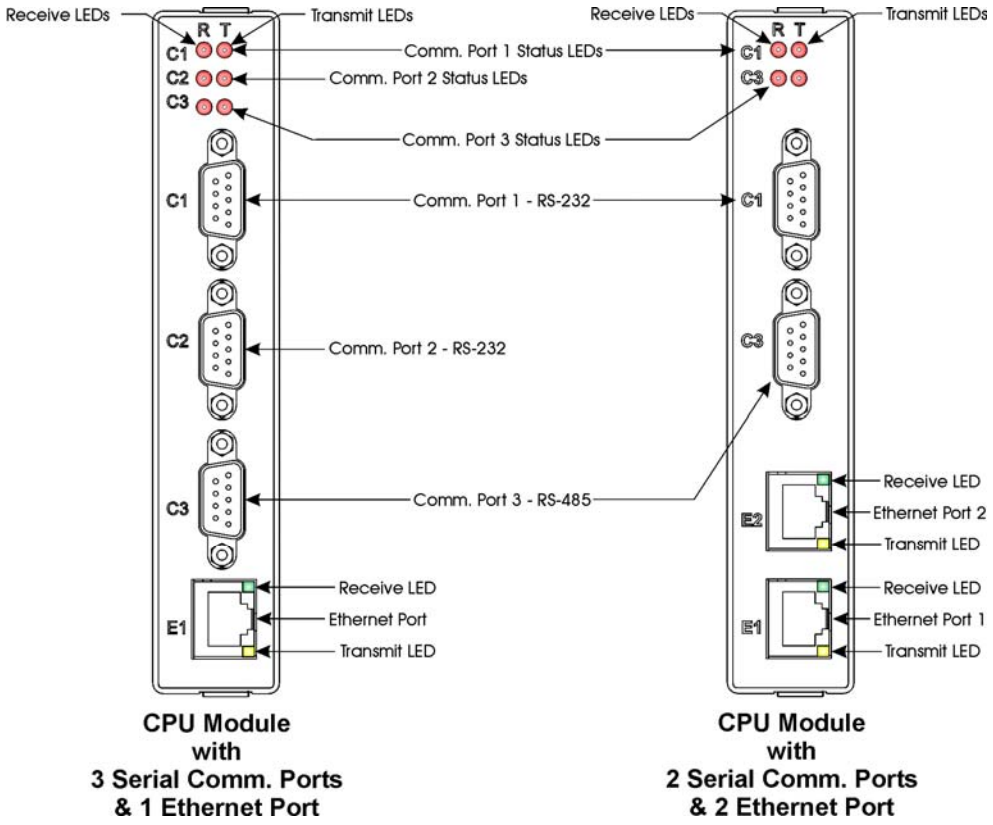


Figure 5-6. CPU Module Comm Connectors and LEDs

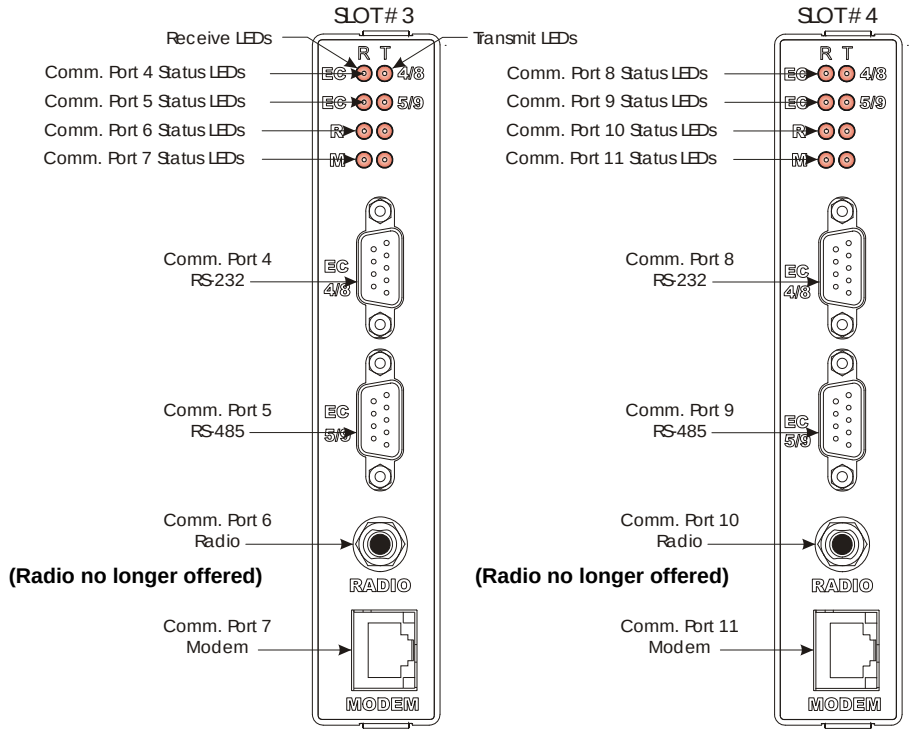


Figure 5-7. Type 1 Expansion Comm Module Comm Connectors and LEDs

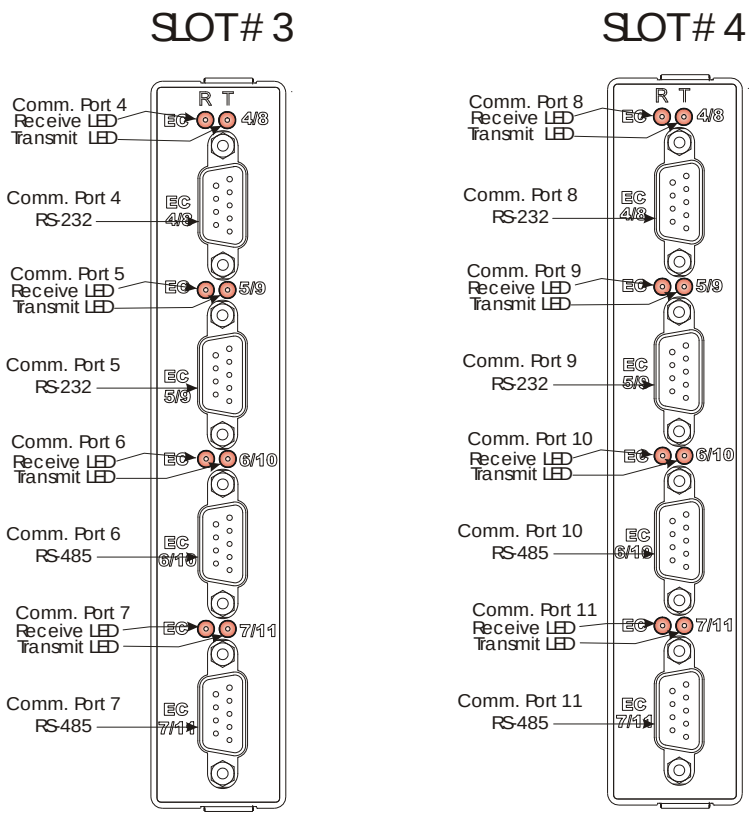


Figure 5-8. Type 2 Expansion Comm Module Comm Connectors and LEDs

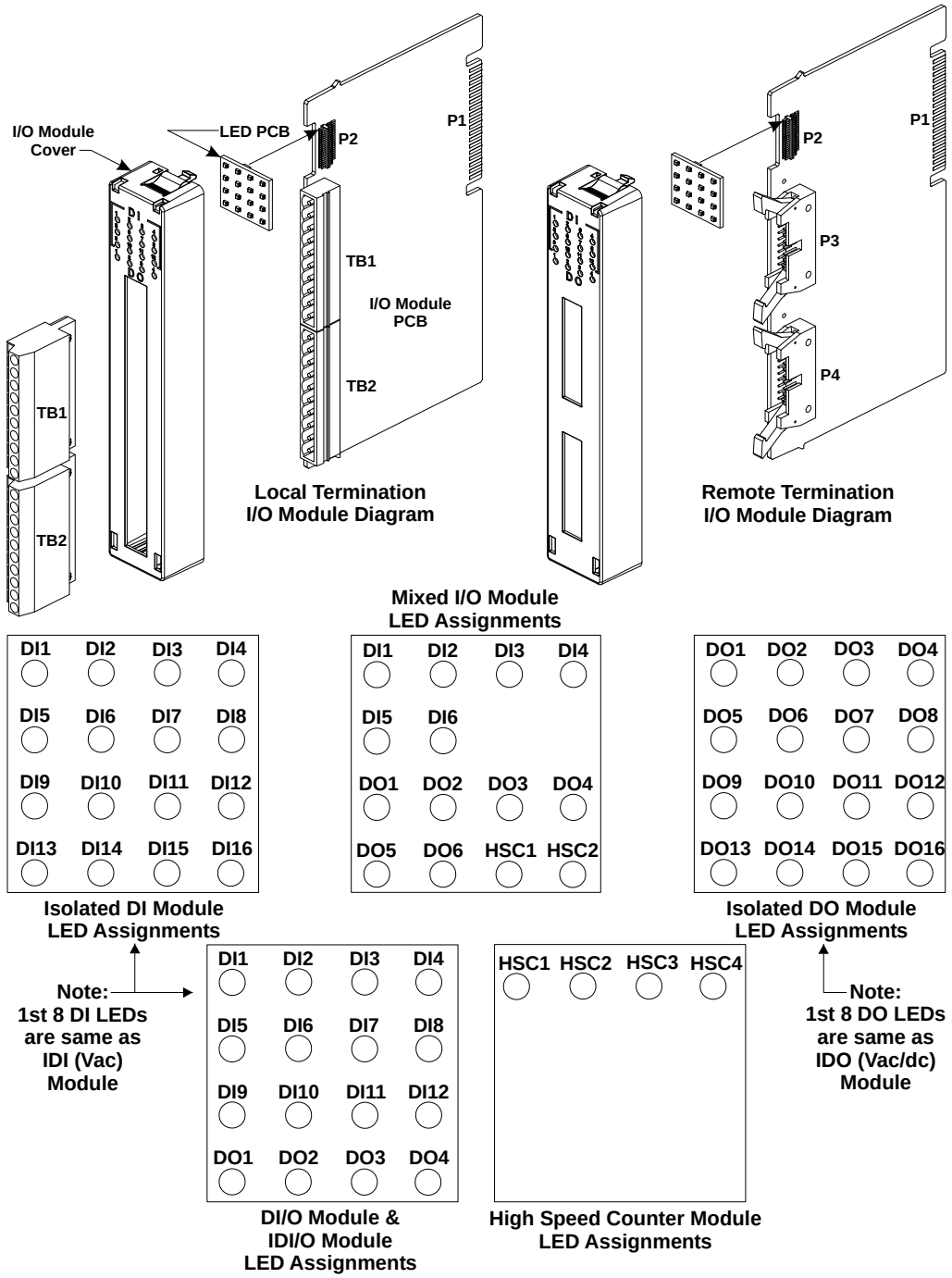


Figure 5-9. I/O Module LEDs

Non-Isolated HART® BTI Interface Module

This module includes 16 status LEDs - one each for transmit (TX), and receive (RX) for eight channels. A receive operation for a channel turns on its associated RX LED; a transmit operation for a channel turns on its associated TX LED.

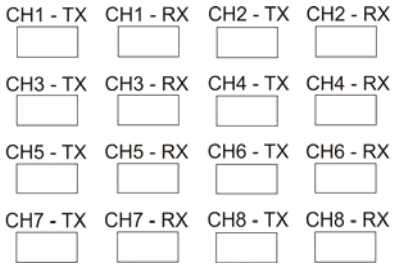


Figure 5-10. Status LEDs on HIB

Note: To conserve power, you can disable the status LEDs by placing jumper W5 in position 2-3.

5.3.2 Checking Wiring/Signals

Check I/O field wiring at the terminal blocks and at the field device. Inspect the wiring for continuity, shorts, and opens. Check I/O signals at their respective terminal blocks (see *Table 5-4*).

Table 5-4. I/O Field Wiring - Terminal Block Reference

I/O Subsystem	Notes
Isolated Digital Inputs	See *Section 3.3*
Isolated Digital Outputs	See *Section 3.4*
Non-isolated Digital I/Os	See *Section 3.5*
Non-isolated Analog I/Os	See *Section 3.6*
Non-isolated HSC Inputs	See *Section 3.7*
Isolated Analog Inputs	See *Section 3.8*
Isolated Analog Outputs	See *Section 3.9*
Non-isolated Mixed I/Os	See *Section 3.10*
Isolated Digital Inputs (Vac)	See *Section 3.11*
Isolated Digital Outputs (Vac/dc)	See *Section 3.12*
Isolated Digital I/Os	See *Section 3.13*
Isolated RTD Inputs	See *Section 3.14*
Isolated Low Level Analog Inputs	See *Section 3.15*
HART/BTI Input	See *Section 3.16*
Watchdog Circuit	See *Section 2.3.7*

5.3.3 Common Communication Configuration Problems

If serial communications do not function, it is often due to one of the following issues:

- Baud rate mismatch – the baud rate at both ends of the communication line must match. If communications fail during a download of a new flash configuration profile (FCP) file, you may have changed the baud rate of the active communication line, since baud rate changes occur immediately on FCP download. You can always re-establish factory default baud rates for communication ports by powering down the unit, and then setting CPU switch SW2-3 to **OFF** and restoring power.
- Incorrect BSAP local address – this address must be an integer from 1 to 127 and must be unique on this particular BSAP communication line. You set the BSAP local address using the flash configuration utility. If this ControlWave Micro is a BSAP slave node, and the range of addresses defined for the BSAP master port end of the communication line does not encompass the local BSAP address defined for this ControlWave Micro, BSAP communications will not function.
- Incorrect EBSAP Group number – if you use expanded BSAP the EBSAP group number must be correct; if you are not using EBSAP, the group number must be 0.

If IP communications do not function, it is often due to incorrect IP addresses or masks. Check to see that the IP address you defined for the ControlWave Micro is compatible with the range of IP addresses defined for the communication line on which the unit resides. Also check that the IP address of the default gateway is correct.

5.4 WINDIAG Diagnostic Utility

WINDIAG is a software-based diagnostic tool you use to test the performance of I/O modules, CPU memory, communication ports, and other system components. .

WINDIAG is a PC-based program, so the Micro must be attached to and communicating with a PC running WINDIAG. Set configuration switch SW2-8 **OFF** (closed) on the CPU module to enable the diagnostic routines.

Establish communication between the Micro (with/without an application loaded) and the PC with a local or network port under the following conditions:

- Turn CPU module switch SW2-8 **OFF** to run the WINDIAG program. Setting this switch off prevents the boot project from running and places the Micro in diagnostic mode.
- Use a null modem cable to connect RS-232 ports between the Micro and the PC; use an RS-485 cable (see *Section 2.4.4*) to connect the RS-485 ports of the Micro and the PC.
- Reserve the port running a diagnostic test for exclusive use; you cannot use that port for any other purpose during testing.
- Connect any Micro communication port to the PC provided their port speeds match. Most PCs have a COM1 port (typically RS-232 and defaulted to 9600 bps operation).
- Configure the Micro communication port to be tested using WINDIAG for 9600 baud, 8-bits, no parity, 1 stop bit, and BSAP/ControlWave Designer protocol operation. Communication port COM1 is only forced to 9600 bps operation when you have set switch SW2-3 on the CPU module to **OFF**.

Table 5-5. COM Port Defaults for Diagnostics

Port	Module	Default Configuation
COM1	CPU	RS-232: 115.2 kbd using IP PPP protocol To run diagnostics, set RS-232 to 9600 baud by setting CPU switches SW2-3 and SW2-8 **OFF**.
COM2	CPU	RS-232: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM3	CPU	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM4	ECOM Types 1 or 2	RS-232: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM5	ECOM Type 1	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
	ECOM Type 2	RS-232: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM6	ECOM Type 1	Not applicable
	ECOM Type 2	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM7	ECOM Type 1	Not applicable
	ECOM Type 2	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM8	ECOM Types 1 or 2	RS-232: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM9	ECOM Type 1	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
	ECOM Type 2	RS-232: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.
COM10	ECOM Type 1	Radio port
	ECOM Type 2	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.

Port	Module	Default Configuation
COM11	ECOM Type 1	Modem port
	ECOM Type 2	RS-485: 9600 baud, 8 bits, no parity, 1 stop bit, BSAP or ControlWave Designer protocol.

You can connect an optional Ethernet port (situated on the CPU module) directly or via a network to a PC equipped with an Ethernet port (see *Section 2.4.5*).

Before starting the WINDIAG program, place any critical processes the Micro is handling under manual control. You cannot run WINDIAG while the Micro is running applications. Set the CPU modules switches SW2-3 and SW2-8 to **OFF**, and perform the following steps:

1. Start the NetView program in OpenBSI with your current network NETDEF file. A menu displays (similar to the one in *Figure 5-11*):

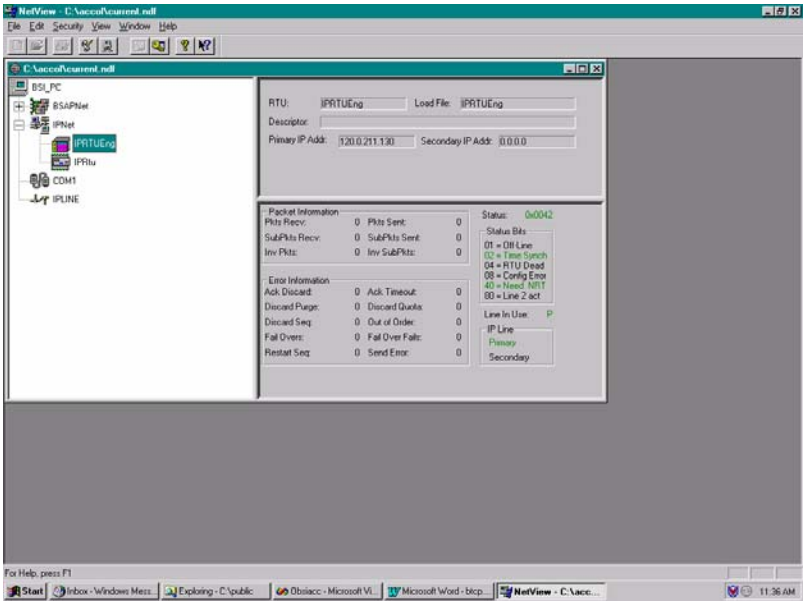


Figure 5-11. NetView

2. Select **Start** >**Programs > OpenBSI Tools** >**Common Tools** > **Diagnostics**. The Main Diagnostics menu (*Figure 5-12*) displays.

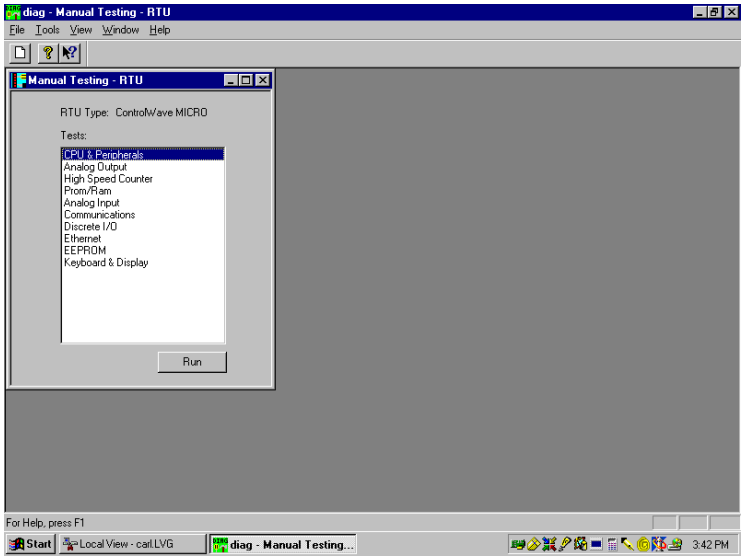


Figure 5-12. WINDIAG Main Diagnostics Menu

3. Select the module to be tested. Enter any prompted parameters (slot #, etc.). WINDIAG performs the diagnostics and displays pass/fail results.

4. After performing all diagnostic testing, exit WINDIAG and then exit the NetView if you don't have any other Micro units to test.

   When you close NetView, the system asks whether you want to close OpenBSI. Select **Yes**.

5. Set switch SW2-8 on the CPU module to **ON** (open). The Micro should resume normal operation.

5.4.1 Available Diagnostics

Using WINDIAG, you can test all Micro modules with the exception of the PSSM. WINDIAG's Main Diagnostics Menu (see *Figure 5-12*) provides the following diagnostic selections:

Option	Tests
CPU & Peripherals	Checks the CPU module (except for RAM & PROM).
Analog Output	Checks AOs on AI/O, AO, or Mixed I/O modules.
High Speed Counter	Checks HSCs on HSC or Mixed I/O modules.
Prom/Ram	Checks the CPU's RAM and PROM hardware.
Analog Input	Checks AIs on AI/O, AI, or Mixed I/O modules.
Communications	Checks Communication ports 1 through 9 (but not COM6 or COM7). The External loop-back tests require the use of a loop-back plug.
Discrete I/O	Checks DIs on DI, DI/O, or Mixed I/O modules and/or checks DOs on DO, DI/O, or Mixed I/O modules.
Ethernet	Checks Ethernet Port 1 or 2. The Loop-back Out

Option	Tests
	Twisted Pair tests require the use of a loop-back plug.
Low Level AI	Checks Thermocouples and CJC on LLAI modules and check RTDs on RTD modules.

Port Loop-back Test

WINDIAG allows you to select the communication port (1 through 4) to test. Depending on the type of network (RS-232 or RS-485) and the port in question, a special loop-back plug is required:

- Ports 1, 2, 4, and 8 (RS-232) use a 9-pin female D-type loop-back plug (shown in *Figure 5-13*).

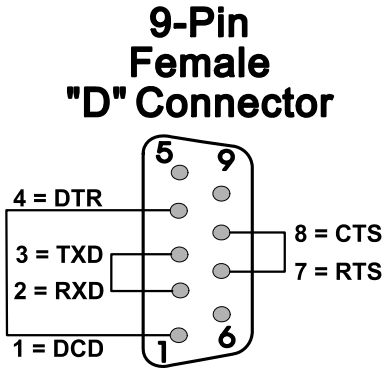


Figure 5-13. RS-232 Loop-back Plug

- Ports 3, 5, and 9 (RS-485) use a 9-pin female D-type loop-back plug (shown in *Figure 5-14*).

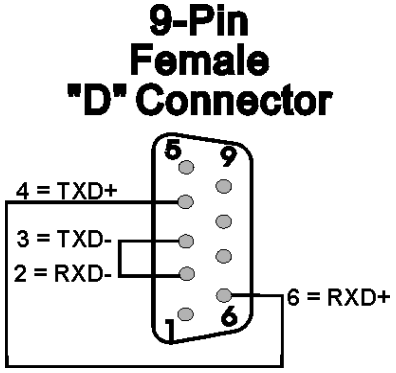


Figure 5-14. RS-485 Loop-back Plug

These tests verify the correct operation of the communication interface on ports COM1 through COM5 and COM8 and COM9.

Note: You **cannot** test a communications port while you are using it. You can only test currently unused ports. After you complete testing on all other communication ports (and verify their correct functioning), you must reconnect (using a now validated port) and test the remaining untested port.

Test Procedure Use this procedure to test the comm ports.

1. Connect an external loop-back plug to the port on the CPU, ECOM1, or ECOM2 module to be tested. Valid ports are:
   - J3 of CPU module for COM1
   - J4 of CPU module for COM2
   - J5 of CPU module for COM3
   - J1 of ECOM1 module for COM4
   - J2 of ECOM1 module for COM5
   - J1 of ECOM2 module for COM8
   - J2 of ECOM2 module for COM9
2. Select **Communications** on the WINDIAG Main Diagnostics Menu. The Communications Diagnostic screen opens:

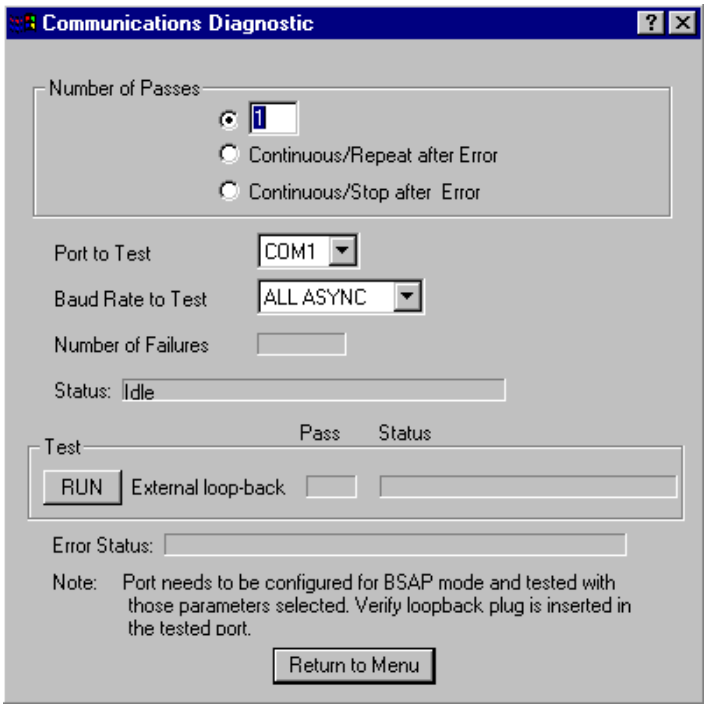


Figure 5-15. Communications Diagnostic Menu

3. Enter **5** in the Number of Passes field.
4. Select a port to test (click ▼ to display all available ports).

Note: The port you select must correlate to the port on which you placed the loop-back plug in step 1.

5. Select **115200** or **ALL ASYNC** as the baud rate (click ▼ to display all available rates).
6. Click **RUN** to start the test. At the completion of the test (which generally takes about 5 seconds), any failed results appear in the Status field to the right of the RUN button:
   - TXD RXD Failure

- CTS RTS Failure

7. Click **Return to Menu** to display the WINDIAG Main Menu.

Ethernet Port Loop-back Test

The **Ethernet** option on the WINDIAG Main Menu allows you to select the Ethernet communication port (1 through 3) to test.

This test configures the Ethernet port's ability to transmit and receive via the twisted pair. The text transmits frames and compares them against received frames. You need a special loop-back plug (shown in *Figure 5-16*) to perform the Ethernet loop-back test:

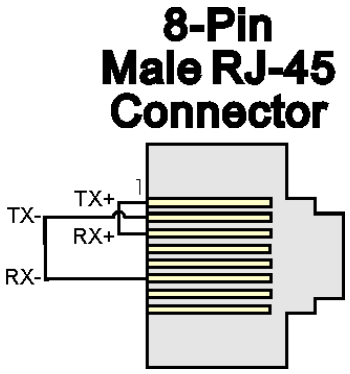


Figure 5-16. RJ-45 Ethernet Loop-back Plug

Note: You **cannot** test a communications port while you are using it. You can only test currently unused ports. After you complete testing on all other communication ports (and verify their correct functioning), you must reconnect (using a now validated port) and test the remaining untested port.

Test Procedure

Use this procedure to test the Ethernet port.

1. Connect an external Ethernet loop-back plug (see *Figure 5-16*) to the Ethernet port on the CPU module to be tested.

2. Select **Ethernet** on the WINDIAG Main Diagnostics Menu. The Ethernet Diagnostic screen opens:

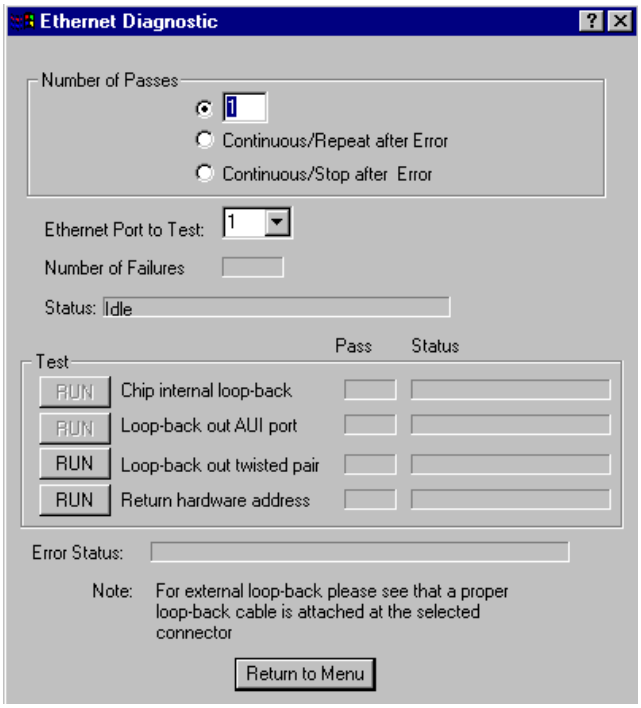


Figure 5-17. Ethernet Diagnostic Menu

3. Enter **1** in the Number of Passes field.
4. Enter **1** in the Ethernet Port to Test field.
5. Click **RUN** next to the Loop-back out twisted pair field to start the test. At the completion of the test, any failed results appear in the Status field next to the **Loop-back out twisted pair** label:
   - No Hardware Present
   - Loop-back Send Failed
   - Loop-back Receive Failed
   - Loop-back Compare Failed
   - Error Information Returned
6. Disconnect the loop-back plug and reconnect the Ethernet cable to the Micro and the Ethernet hub.
7. Click **Return to Menu** to display the WINDIAG Main Menu.

5.5 Core Updump

In some cases—such as when a Micro fails for no apparent reason—you can upload a copy of the contents of SRAM and SDRAM to a PC for support personnel and service engineers to evaluate. This upload is called a "core updump."

A core updump may be required if the Micro spontaneously enters a watchdog state that affects all system operation. This occurs when the system crashes as a result of a CPU timeout (resulting from improper software operation, a firmware glitch, and so on). In some cases, the

watchdog state can recur but you cannot logically reproduce the conditions.

The CPU module's RAM contains "crash blocks," a firmware function provided specifically for watchdog troubleshooting. You can view and save the crash blocks by viewing the Crash Block Statistic Web Page (see the *Web_BSI Manual*, D5087). On request, you can forward crash block files to our technical support personnel. If they need additional information to evaluate the condition, the technical support group may request a core updump. Once the core updump process generates a file, you can forward that file to the support personnel for evaluation and resolution.

Use the following steps to preserve the "failed state" condition at a system crash and perform a core updump:

1. Set switch SW2-1 on the CPU module to **OFF** (Disable Watchdog Timer). If switch SW2-4 is **ON**, set it to **OFF** (Enable Core Updump).

   Note: The factory default setting for switch SW2-4 is **OFF**.

2. Wait for the error condition (typically 3F on the PSSM's status LEDs).
3. Connect the ControlWave Micro's Comm Port 1 to a PC using a null modem cable.
4. If the Micro's PSSM has a Run/Remote/Local switch, set it as follows:

   Note: You must perform each step in less that one second.

   a. Set Run/Remote/Local switch to **Run**
   b. Set Run/Remote/Local switch to **Remote**
   c. Set Run/Remote/Local switch to **Local**
   d. Set Run/Remote/Local switch back to **Remote**
   e. Set Run/Remote/Local switch back to **Local**

   If the PSSM has an SW1 mode switch, set it for Recovery Mode: set **both** SW1-1 and SW1-2 to the right for open operation or both to the left for closed operation.

5. Start the PC's HyperTerminal program (at 115.2 kbaud) and generate a receive using the 1KX-Modem protocol. Save the resulting core updump in a file so you can forward it later to the technical support group.

By setting the CPU module switches SW2-1 and SW2-4 both off **before** the Micro fails, you prevent the Micro from automatically recovering from the failure and enable it to wait for you to take a core updump.

Once you complete the core updump, set the CPU module's switch SW2-1 to **ON** (Watchdog Enabled) and SW2-4 to **OFF** (Core Updump Enabled).

Additionally, if the PSSM has a mode switch, set switch SW1-1 to open (right) and SW1-2 to closed (left). If the PSSM has a Run/Remote/Local switch, set it to Local.

With these switches set, power up the Micro and recommence standard operations.

Appendix A – ControlWave Micro Process Automation Controller – Special Instructions for Class I, Division 2 Hazardous Locations

1. The ControlWave Micro Process Automation Controller is listed by Underwriters Laboratories (UL) as nonincendive and is suitable for use in Class I, Division 2, Groups A, B, C and D hazardous locations and non-hazardous locations only. Read this document carefully before installing a nonincendive ControlWave Micro Process Automation Controller. In the event of a conflict between the ControlWave Micro Customer Instruction Manual (*CI-ControlWave Micro*) and this document, always follow the instructions in this document.
2. All power and I/O wiring must be performed in accordance with Class I, Division 2 wiring methods as defined in Article 501-4 (b) of the National Electrical Code, NFPA 70, for installations within the United States, or as specified in Section 18-152 of the Canadian Electrical Code for installation in Canada.

WARNING

EXPLOSION HAZARD

Substitution of components may impair suitability for use in Class I, Division 2 environments.

WARNING

EXPLOSION HAZARD

When situated in a hazardous location, turn off power before servicing / replacing the unit and before installing or removing I/O wiring.

WARNING

EXPLOSION HAZARD

Do NOT disconnect equipment unless the power is switched off or the area is known to be non-hazardous.

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Appendix D – Modem Installation

D2.1 Modem Installation & Configuration

D2.1.1 Installing an Internal MultiTech Modem (MT9234SMI)

To install a Model MT9234SMI Modem onto an ECOM Module, perform the following steps:

Remove the ECOM Module from the controller (see *Figure D1*).

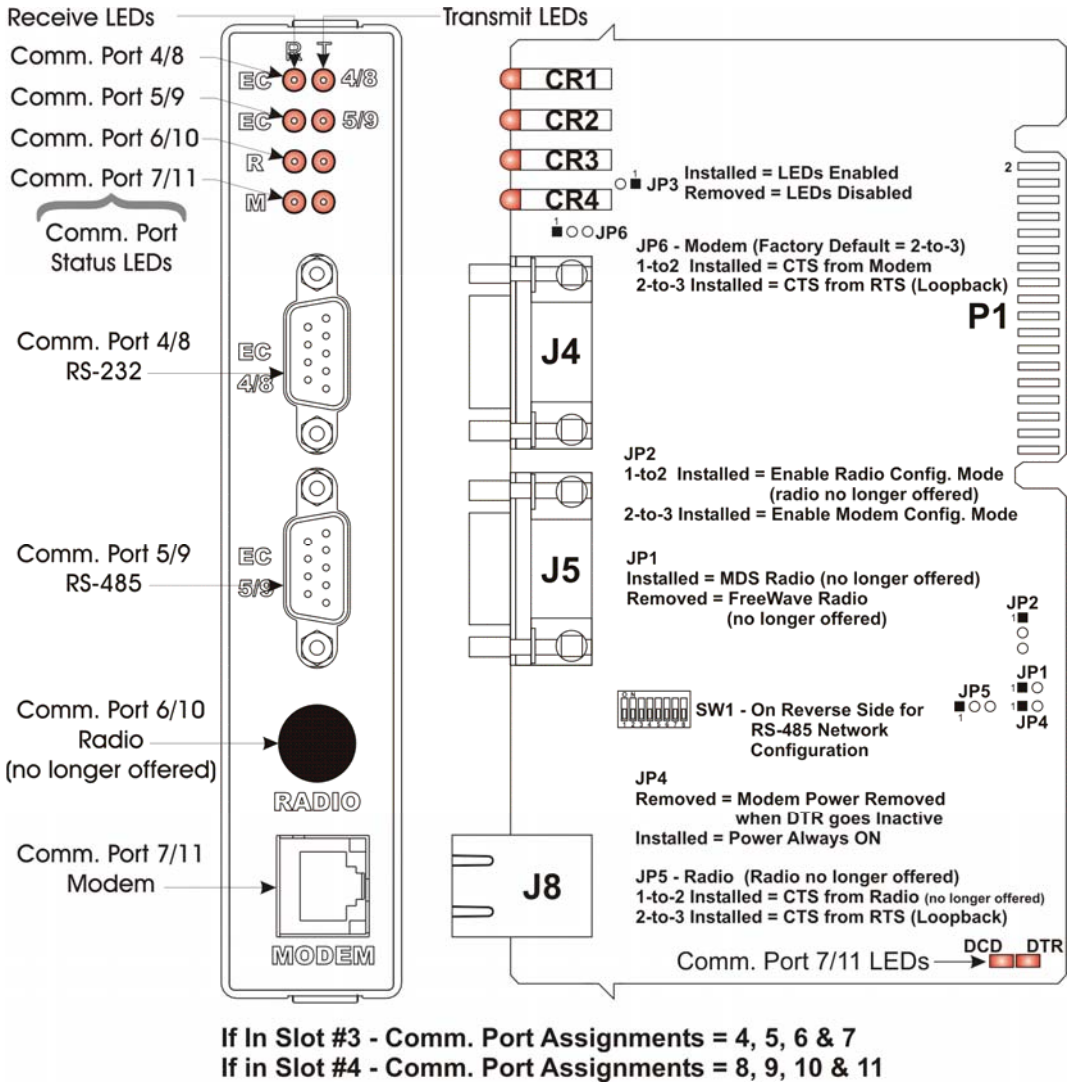
Receive LEDs
Transmit LEDs
Comm. Port 4/8
Comm. Port 5/9
Comm. Port 6/10
Comm. Port 7/11
Comm. Port Status LEDs
Comm. Port 4/8 RS-232
Comm. Port 5/9 RS-485
Comm. Port 6/10 Radio (no longer offered)
Comm. Port 7/11 Modem
RADIO
MODEM
CR1
CR2
CR3
CR4
JP3 Installed = LEDs Enabled Removed = LEDs Disabled
JP6
JP6 - Modem (Factory Default = 2-to-3)
1-to2 Installed = CTS from Modem
2-to-3 Installed = CTS from RTS (Loopback)
P1
J4
J5
J8
JP2
1-to2 Installed = Enable Radio Config. Mode (radio no longer offered)
2-to-3 Installed = Enable Modem Config. Mode
JP1
Installed = MDS Radio (no longer offered)
Removed = FreeWave Radio (no longer offered)
SW1 - On Reverse Side for RS-485 Network Configuration
JP4
Removed = Modem Power Removed when DTR goes Inactive
Installed = Power Always ON
JP5 - Radio (Radio no longer offered)
1-to-2 Installed = CTS from Radio (no longer offered)
2-to-3 Installed = CTS from RTS (Loopback)
Comm. Port 7/11 LEDs
DCD
DTR
If In Slot #3 - Comm. Port Assignments = 4, 5, 6 & 7
If in Slot #4 - Comm. Port Assignments = 8, 9, 10 & 11

Figure D1. Expansion Comm. Module Component Identification Diagram

1. Unplug the antenna cable from the RF Connector on any installed radio module. Grasp the ECOM Module with one hand. Squeeze both sides of the cover panel (just below the unit's top) and pull up and away to release the cover panel and EMI Gasket from the PCB (see *Figure D2).*

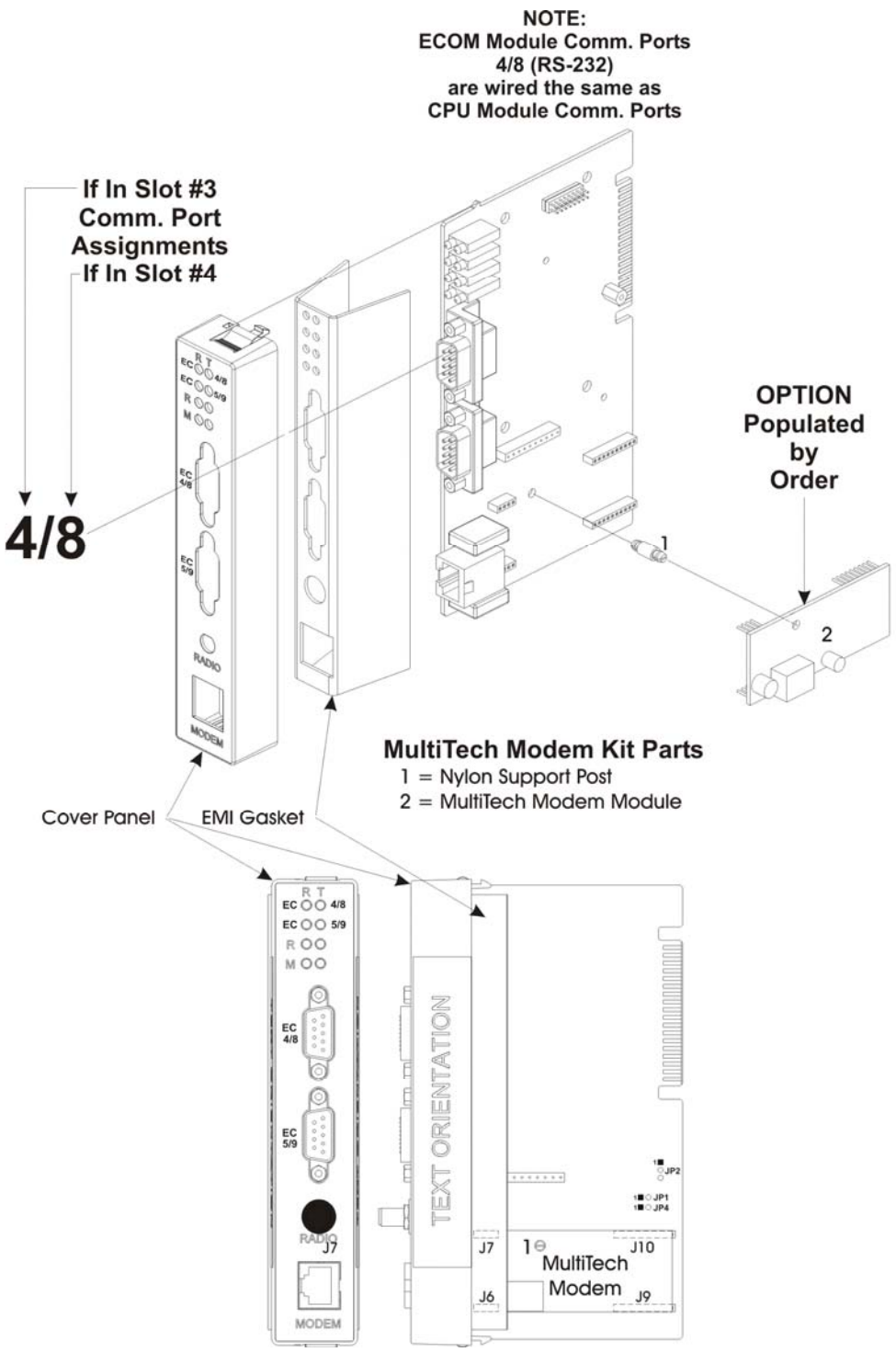

Figure D2. MultiTech Modem Installation Diagram

Note: If necessary, you can use a small screwdriver to pry the cover panel from the PCB.

2. Install the nylon support post included in the kit onto the ECOM Module.

3. Mount the MultiTech Modem to the ECOM Module making sure that the interface connectors (J6, J7, J9 & J10 on the ECOM Module) align.
4. Plug the antenna cable(s) (if present - removed in Step 2) into the appropriate RF connector of an installed radio module(s).
5. Snap the cover panel onto the ECOM Module PCB and insert the ECOM Module into the appropriate backplane slot, i.e., Slot 3 or 4.
6. Apply power and test the unit.

D2.1.2 Configuring the MultiTech Modem (MT9234SMI)

To configure a model MT9234SMI Modem (installed on an ECOM Module), perform the following steps:

1. If required, remove the ECOM Module from the controller (see *Figure D1*).
2. Place the modem into configuration mode by setting ECOM Module jumper JP2 onto pins 2 and 3. This enables configuration of the modem through Comm. Port 4 for modem on ECOM1 or through COMM. Port 8 for modem on ECOM2.
3. Connect a full duplex ControlWave null modem cable (see *Figure D3*) between a PC and Comm. Port 4 (ECOM1) to configure modem on ECOM1 or Comm. Port 8 (ECOM2) to configure modem on ECOM2.

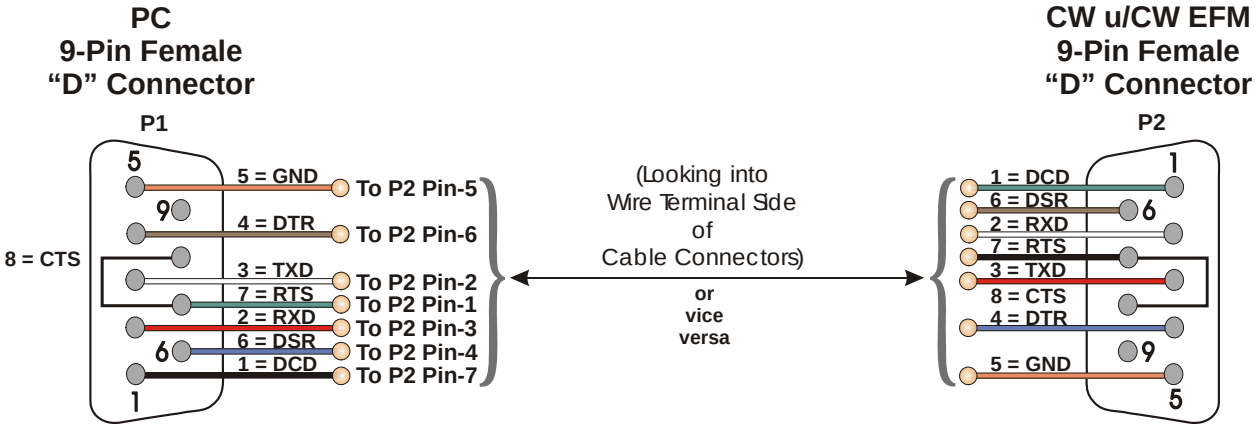

Figure D2. Internal Modem Configuration P/N 392843-01-3 Full-duplex Null Modem Cable Diagram

4. Open HyperTerminal on the PC and set the PC communication port settings as follows:

- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bit: 1
- Flow Control: None
- Send Factory Default AT&F0.
- Disable Flow Control AT&K0.
- Set baud rate using AT Command for example:
  AT$SB9600,
  (Modify for whatever baud rate you require.)
- Write to memory AT&W.

5. Set ECOM Module configuration jumper JP2 into a storage position.

Appendix Z – Sources for Obtaining Material Safety Data Sheets

This device includes certain components or materials which may be hazardous if misused. For details on these hazards, please contact the manufacturer for the *most recent* material safety data sheet.

Manufacturer	General Description	Emerson Part Number & Media Notes
DURACELL (DL 2032) http://www.duracell.com PANASONIC (CR 2032) http://www.panasonic.com ENERGIZER (CR 2032) http://www.energizer.com SANYO (CR 2032) VARTA (CR 2032) http://www.varta-microbattery.com	LITHIUM MANGANESE DIOXIDE COIN CELL BATTERY	W15020X0012

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